Regional and Seasonal Attributes of Catch in the British Columbia Troll Fishery

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REGIONAL AND SEASONAL ATTRIBUTES OF CATCH IN THE BRITISH COLUMBIA TROLL FISHERY

by

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ABSTRACT

Healey, M. C. 1986. Regional and Seasonal Attributes of Catch in the British Columbia Troll Fishery. Can. Tech. Rep. Fish. Aquat. Sci. No. 1494: 65 p.

This report summarizes information on the composition of the catch of troll fishing vessels taken from log book records provided by a group of fishermen during 1981-1983. Information on all five species is presented. Overall composition of catch calculated from log book data was not identical to that calculated from landing statistics, however, the log book program sampled only a small fraction of the fishing vessels. Significant variation in catch-per-hour values was observed for all species (except chum for which catches were very small) between areas of the coast, seasons of the year, and years of the study. Some patterns appeared sufficiently persistent from year to year, however, that they could provide a basis for a management. It also appeared possible, in some instances, to trade-off catch of one species, or size grouping within a species, for catch of another species or size grouping.

Consistent with the observations of others, size and age of chinook and coho increased from south to north along the British Columbia coast. However, the variation in size and age along the west coast of Vancouver Island was almost as great as the variation that occurred along the whole British Columbia coast. A previously unobserved phenomenon was that females predominated in the catch of both chinook and coho, and that the proportion of females in the catch increased from south to north along the coast. There is no obvious explanation for the preponderance of females among the coho catch, or for the geographical change in sex ratio. For chinook, at least part of the variation in sex composition, and its departure from a ratio of 1:1, lies in the fact that female chinook mature at an older age than male chinook.

Diets of both species were dominated by herring and sandlance. Euphausiids were somewhat more important in the coho diet, especially off southwestern Vancouver Island, and coho had a slightly more varied diet than chinook.

RESUME

Healey, M. C. 1986. Regional and Seasonal Attributes of Catch in the British Columbia Troll Fishery. Can. Tech. Rep. Fish. Aquat. Sci. No. 1494: 65 p.

Le présent rapport résume les données sur la composition des prises des cinq espèces de saumon réalisées par la flottille de pêche aux lignes traînantes. Ces données ont été tirées des journaux de bord fournis de 1981 à 1983 par un groupe de pêcheurs. La composition globale des prises calculée à l'aide de ces donées n'était pas pareille à celle générée par les statistiques sur les débarquements; cependant, le relevé des journaux de bord ne portait que sur une petite partie des navires de pêche. Chez toutes les espèces, on a observé d'importantes variations des prises par heure (sauf pour le saumon kéta dont les prises étaient faibles) en fonction des zones côtières, des saisons et des années étudiées. Toutefois, on a observé d'une année à l'autre certaines tendances qui pourraient servir de base de gestion. Dans certains cas, il semble aussi possible d'échanger les prises d'une espèce, ou du groupe de taille d'une espèce, avec les prises d'une autre espèce ou d'un autre groupe de taille.

Comme d'autres chercheurs l'ont remarqué auparavant, la taille et l'âge des saumons quinnat et coho augmentent du sud au nord le long du littoral de la Colombie-Britannique. Toutefois, la variation de la taille et de l'âge sur la côte ouest de l'île Vancouver était presque aussi élevée que la variation observée sur tout le littoral. Dans les prises de quinnats et de cohos, les femelles l'emportaient en nombre et leur proportion augmentait du sud ou nord; ceci est un phénomène observé pour la première fois. Il n'y a pas d'explication évidente de cette dominance des femelles dans les prises de cohos ou de la variation géographique de la proportion relative des sexes. Dans le cas du quinnat, au moins une partie de cette variation et son écart du rapport 1:1 provient du fait que les femelles quinnats atteignent la maturité à un âge plus avancé que les mâles.

Chez les deux espèces, le régime alimentaire était composé en grande partie de hareng et de lançon. Surtout au large de la côte sud-ouest de l'île Vancouver, les euphausiacés étaient légèrement plus fréquents dans le régime alimentaire des cohos qui était un peu plus varié que celui des quinnats.

INTRODUCTION

The troll (hook and line) fishery is an important component of Canada's Pacific salmon fishery. Approximately 20,000 tons of salmon, mainly chinook and coho (Oncorhynchus tshawytscha and O. kisutch) are landed by trollers annually. While this constitutes only 30% of total salmon landings trollers harvest 75% of chinook and coho.

Trollers are mobile and wide ranging. Boats that preserve their catch in ice normally stay at sea 10-12 days between landings while boats that freeze their catch may deliver their catch only once every 60 days or more. During a single fishing trip a troller may fish in several fishery management statistical areas.

The standard record of catch for British Columbia fisheries is derived from catch sales slips filled out at the time fish are landed. Sales slips record only the date of landing, the number of days fished, and, typically, only a single fishing area. Consequently the sales slips provide a poor record of both when and where trollers catch their fish. Furthermore, since trollers land their fish dressed, certain kinds of information about the catch, such as its sex composition, cannot be obtained from samples collected where fish are landed.

Overfishing of coho and chinook stocks (Healey 1982; Pearse 1982) and bilateral agreements with the U.S. regarding interception and management of salmon stocks necessitate greater control over the ocean harvest of these two species. Uncertainties in the information available on the troll fishery mitigate against the design of efficient fishing plans that will meet the needs of resource conservation, the terms of international agreements, and the desire for equitable allocation of chinook and coho among Canadian fishermen. Consequently, in 1981 the Fisheries Research Branch of the Department of Fisheries and Oceans initiated an investigation of catch success and catch composition in the British Columbia troll fishery. The investigation had two broad objectives: (1) to describe seasonal and regional variation in catch rate and catch composition for trollers; and (2) to relate fleet distribution to capture success and oceanographic conditions. The purpose of this report is to present the findings of this study with respect to the first objective.

METHODS

By means of log books that the Branch supplied, trollers collected daily information on catch, weather and ocean conditions. In these log books the fishermen were to record, during each of three daily time periods (< 1000 hrs, 1000-1600 hrs, > 1600 hrs), the number of hours spent fishing, the number of each salmon species landed, the number of each salmon species caught and released, the number of each non-salmon species captured, and the location fished (loran coordinates and/or geographic location). The fishermen were also to measure the fork lengths of chinook and coho up to a maximum of 25 per each species, to record information on stomach contents, to collect scales

from the chinook salmon for age analysis, to record the sex of the fish, and to search for fish with missing adipose fins. Fish with the adipose fin missing were to be marked with a strap tag for later recovery and examination for an internal coded wire tag that would indicate stock and country of origin. The fishermen were also to note which species, if any, they were attempting to capture so that other species captured could be considered incidental catch.

The manner of recording stomach contents differed in 1981 from 1982 and 1983. In 1981 the fishermen were given a list of the most important known diet items of chinook and coho and asked to indicate the approximate percentage of stomach contents each item comprised. In 1982 and 1983 the fishermen were first to note whether the stomach of each fish was empty, <1/2 full, or >1/2 full and then to note the principal food in each stomach.

In 1981 the fishermen were to record, during each daily time period, per cent cloud cover, wind speed and direction, and depth of water in which they were fishing. In 1981 the Branch also placed observers aboard some vessels whose job it was to record the log book entries and to collect additional ocenaographic information including water samples for chlorophyll analysis, water colour estimates, water temperature and secchi depth. It proved virtually impossible to collect oceanographic samples reliably while the troller was underway and fishing, so the more detailed oceanographic observations from trollers were discontinued in 1982 and 1983. Fishermen were, however, still requested to record sky and sea conditions and water depth.

The Branch placed observers aboard some vessels in 1981 partly to provide a baseline for information quality against which to compare that provided by fishermen themselves. It was clear from the results in 1981 that fishermen were just as conscientious about recording observations as were observers. The program, therefore, depended entirely on fishermen to provide information in 1982 and 1983. During these two years each fisherman signed a contract to provide certain kinds of information and was paid $20.00 per day for each day of information provided. Unfortunately this proved to be an insufficient incentive to ensure that all fishermen would thoroughly examine their catch for potential tags. Tag return rates from this study are not, therefore, an accurate measure of incidence of tagged fish.

In 1981, 35 vessels reported catch, in 1982, 20 and in 1983, 26 (Table 1). Nine vessels provided information in all 3 years and 7 other vessels provided information in 2 years. The sample of vessels, thus, represented 1.5 - 2.5% of the coastal fleet of about 1200 trollers. During 1981 and 1982 the vessels reporting were mainly those that fished off the west coast of Vancouver Island, so that relatively little information came from the central and northern parts of the coast. During 1983, however, more vessels that fished on the north coast were recruited to the project, so that information from 1983 is more representative of the central and north coasts (Table 1). Although fewer vessels participated in 1982 and 1983 than in 1981, the number of fishing hours for which catch was reported was considerably greater in 1982 and 1983 (Table 1).

Observations collected during the study were aggregated over fishery statistical areas to increase sample size from regions in which there were few

observations. The aggregated statistical areas included the north coast (statistical areas 1-5; Fig. 1), the central coast (statistical areas 6-12; Fig. 1), northwest Vancouver Island (statistical areas 25-27; Fig. 1), central Vancouver Island (statistical areas 23-24, Fig. 1), and Swiftsure Bank (statistical area 21, Fig. 1). The Swiftsure Bank area was given special consideration because it was an area known to have a high concentration of undersized fish.

The information collected during this study is on computer files at the Pacific Biological Station in Nanaimo. Statistical comparisons were made for each species in the catch by analysis of variance (factorial design) with fishing areas and months as treatments and years as replicates. The analyses were performed by means of the Statistical Analysis System of SAS Institute Inc.

REGULATIONS GOVERNING THE TROLL FISHERY

A few general regulations govern the troll fishery coastwide. In addition, special regulations are enacted from time to time to deal with specific problems. Among the general regulations are those governing areas and times of fishing. Currently trollers are licenced to fish either "inside", within the Strait of Georgia and adjoining straits (statistical areas 12-20 and 28-29) or "outside", elsewhere on the coast. Trollers must commit themselves annually to fishing inside or outside. Statistical areas 12 and 13 (Fig. 1) constitutes a "grey" zone in which trollers holding either licence may fish. The log book survey did not include the Strait of Georgia fishing area. The trolling season for chinook salmon opened on 15 April each year and closed on 30 September. The trolling season for coho opened on 1 July each year and closed on 30 September. Capture of pink, sockeye and chum was permitted during the chinook open season but in some inshore areas was often restricted to the times and areas that were also open for net fishing. In July 1981 trollers fishing off the west coast of Vancouver Island (areas 21-27; Fig. 1) were restricted in their capture of pink salmon to a number not exceeding 33% of their combined coho and chinook catch. During 1982, north and central coast fishing areas (statistical areas 1-11) were closed to trolling from 10-24 June and, in 1983, the same areas were closed during 17-30 June as a conservation measure for chinook. At various times prior to July during 1981 and 1982 Swiftsure Bank (area 21) and part of area 23 (south bank) were closed to trolling to reduce the capture of undersized chinook and out of season coho. These and a few other minor closures and regulations pertaining to the troll fishery are outlined in Table 2.

Trollers may be of any gross tonnage and are permitted to fish six lines simultaneously. There are no restrictions on the type, size, or design of artificial lures that may be used in the fishery, except that barbless single hooks are required prior to the opening of the coho season unless fixed to a plug no smaller than 12 mm diameter x 150 mm long.

Minimum size limits for chinook were 62 cm fork length or 51 cm

head-off and for other species were 48 cm fork length or 40 cm head-off. After July 1 pink and sockeye could be retained as small as 30 cm fork length or 26 cm head-off.

RESULTS

COMPARISON OF LOG BOOK RECORDS WITH TOTAL LANDINGS

Comparison of the catch composition of trollers who kept log books with total landings in different regions of the coast revealed that the log book data may not accurately reflect total landings in some instances (Table 3). This was particularly the case in 1981 when rather large differences in percent composition occurred in all regions. In most instances the differences reflected too high an abundance of chinook and too low an abundance of pink in the log book records as compared to total landings. The percentage of coho in the log book records, although showing no consistent trend, also was seldom the same as in the total landings. Agreement between total landings and our log book records was better in 1982 and 1983.

In part these disagreements between log book and total landings seem related to the small number of fish contributing to the log book records in some instances rather than directly to the number of boats involved. It is not surprising, however, that catch composition in the log book records differs somewhat from total landings since such a small proportion of the catch and fleet were sampled.

Catch-Per-Hour of Legal and Undersized Chinook

Catch-per-hour of legal sized chinook varied from 0.114 to 1.243 between fishing areas and months. Catch rates for legal sized fish tended to be high early in the season and declined as the season progressed (Table 4), and these month to month changes were statistically significant ($F = 27.8$; $P < 0.0001$). Single degree of freedom comparisons (Tukey's HSD test) revealed that the catch rate in April was significantly higher than all subsequent months, as was the catch rate in May. Catch rates in June and August were similar but greater than the catch rates in July and September. Declines in catch rate of chinook after the end of June may well be due to some fishermen concentrating their efforts on coho or other species and thereby reducing their efficiency of capture for chinook.

The overall pattern of seasonally declining catch rate was not consistent for all fishing areas, however, as evidenced by the significant area x month interaction in the analysis of variance (Table 4). In fact, when individual fishing areas were considered, the pattern of declining catch rate was only readily apparent in areas 21 and 23-24, but since overall catch rates were highest in these areas, this pattern dominated the seasonal means (Table 4).

Rate of catch also varied significantly between areas. Single degree of freedom tests indicated that areas 21 and 23-24 had catch rates that were similar (0.742 and 0.731 respectively) but significantly higher than catch rates elsewhere (in the range 0.464-0.303). The catch rate for area 1-5 was also significantly higher than the rates for areas 6-12 and 25-27 (Table 4).

In summary, therefore, catch rates for legal sized chinook were highest early in the season and in the most southern fishing areas. Consistent patterns were apparent both between months and between areas but seasonal changes in chinook catch rate were not always the same in different areas. The individuality of behaviour among areas may reflect local responses to the opening of the coho season and the appearance of pink, sockeye and chum in troll fishing areas as well as seasonal variation in the availability of chinook salmon.

The catch rates that we observed for legal sized chinook along the west coast of Vancouver Island were somewhat higher than the catch rates estimated by Pitre (1970) for 1968 and 1969, but were smaller than the rates observed by Tully (1954) for 1938-1940. The differences were not dramatic, however, the range from smallest to largest catch rate being 0.65-1.12 chinook per hour. Tully (1954) also presented data for catch rates in the central coast during 1939 and 1940, and these were comparable to the rates that we observed in 1981-1983.

Catch of undersized chinook varied 0.061 to 2.007 per hour, that is over a wider range than the rate of catch for legal sized chinook (Table 4). Variation between months was significant ($F = 19.6$; $P < 0.001$). Catch rate of small chinook was high in April, declined until June, and increased again in September (Table 4). Single degree of freedom tests showed that catch rates of undersized chinook were the same in April (0.826) and September (0.845), but were greater during these months than in all other months. The catch rate of undersized chinook was also significantly greater in May (0.671) than in June (0.381), and significantly greater in June than in July (0.252) and August (0.254).

Catch rates for undersized chinook also varied significantly between areas ($F = 240$; $P < 0.0001$), being highest in area 21 (1.675) and lowest in areas 1-5 (0.142). By single degree of freedom tests catch rates for sublegal chinook were greater in area 21 than in area 23-24, greater in area 23-24 than in area 6-12 and greater in area 6-12 than in areas 1-5 and 25-27 (Table 4). The ratio of sublegal to legal sized chinook in the catch off the west coast of Vancouver Island was somewhat higher in all areas than that estimated by Pitre (1970) in 1968 and 1969.

The area x month interaction in the catch rates for undersized chinook was significant and arises because of different seasonal patterns of capture in the various fishing areas (Table 4). Off southwest Vancouver Island catch of undersized fish was highest early and late in the fishing season, and this was also the area of greatest catch of sublegal chinook so that this pattern dominated the seasonal means. Off north west Vancouver Island and in the central coast, however, there was no obvious seasonal pattern of catch rate for undersized fish, and in the north coast the catch

rate for undersized fish was greatest in the middle of the fishing season (Table 4).

In summary, therefore, catch rates for undersized chinook were highest during the first and last months of the fishing season and lowest during July and August off southwestern Vancouver Island, in the areas where catch rates of undersized fish were greatest. Regional differences in the incidence of undersized fish were apparent, the incidence being greatest off southwestern Vancouver Island and lowest in the north coast and off northern Vancouver Island. Of particular importance is the fact that the catch/hr of undersized chinook was more than twice as great as the catch/hr of legal sized chinook in area 21, and almost as great as the catch of legal sized chinook in areas 23-24. If the mortality rate of chinook released in the fishery is on the order of 30-50% (Ricker 1976; Wright 1972) then the incidental mortality of small chinook due to hooking is as great in area 21 as the mortality due to landings, and is also disturbingly high in areas 23-24, particularly during April and September.

Catch-per hour of Legal and Undersized or Out-of-Season Coho

Since the fishing season for coho did not open until 1 July each year, no appreciable landings were recorded before that date, although some trollers did take advantage of the June 28 opening for coho in areas 9-11 and 21-27 during 1982. Catch rates were generally high during July in all fishing areas, and averaged 4.34 fish/hr overall (Table 5). Catch rates during other months were significantly lower ($F = 89.8$, $P < 0.0001$). Catch rates for coho also varied among fishing areas being highest overall for areas 21 and 23-24, and significantly lower in all other areas (single degree of freedom tests). There was also a significant area x month interaction that, presumably, reflects the rate of drop in catch after July, which was very rapid in some areas (e.g. 25-27, 1-5) yet slow in others (e.g. 21).

Tully (1954) also reported rates of catch for coho off Vancouver Island and in the central coast during 1938-1940. In all areas the rates reported by him were greater than those that we observed with the exception of southwestern Vancouver Island. Tully (1954) had few observations from this area, however.

Release rates for coho were greatest during the chinook only season (April-June), and were significantly greater during these months than at other times of year. Release rates were also significantly greater during September than during July and August. Coho which had entered salt water during the spring became vulnerable to troll gear in September, and it was the presence of these fish which caused the increase in release rate during September.

Release rates also differed among areas, being greatest in area 21 (0.973 per hour) and lowest in areas 25-27 (0.116 per hour). Release rates were also relatively high in areas 23-24 (0.521 per hour). Overall, however, the release rate for coho was much less than the rate of capture of legal sized fish, unlike chinook in which the rates of capture of legal and undersized fish were about the same. Coho shakers were generally about as abundant in the early season catch as legal chinook in this study. Pitre

(1970), however, found coho shakers to be generally more abundant than legal sized chinook in the early season catch during 1968 and 1969.

Catch-per-hour of Pink Salmon Landed and Released

Since the odd and even year brood lines of pink salmon are totally separate (a result of their rigid two year life cycle), and because the relative abundance of the two lines differs, the 1981 and 1983 catch data for pink were analyzed separately from the 1982 data.

In 1981 and 1983 there was strong seasonal variation in catch rate of pinks, presumably reflecting the timing of returns of this species from the open North Pacific to coastal spawning streams, but also reflecting the distance of the troll fishing areas from the spawning streams, and any regulations governing the capture of pink salmon (Table 6). Overall greatest catch was in August, but the time of peak catch was different in the different fishing areas. Catch peaked in July in the north coast, in September in the central coast and in August off western Vancouver Island. Differences in catch rates between areas were also apparent. Catch rates were highest in areas 25-27, lower in the north and central coasts, and lower still off central and southwestern Vancouver Island (Table 6). Since most of the catch off western Vancouver Island is of returning Fraser River fish, low catches of pinks off central and southwestern Vancouver Island may in part have been due to regulations restricting the capture of pink salmon off Vancouver Island. The drop in catch rate from north to south along Vancouver Island may also have been due to cessation of feeding by pink salmon as they get closer to their home river, and to fishing preferences of fishermen.

A significant area x month interaction was present in the catch rates, and reflects the different seasonal patterns of catch among the fishing areas. The catch in areas 25-27 was considerably larger than catch in any of the other areas, and the overall seasonal pattern was dominated by this catch. The overall high coastwide catch in August was partially reinforced, however, by relatively high catches in the central and north coasts during August (Table 6).

Numbers of pinks released was greatest during July in all coastal regions, and was generally low at all other times (Table 6). The fact that large numbers of pinks were neither landed nor released in fishing areas off central and southwestern Vancouver Island, when these areas are on the migration route for Fraser River pink salmon, suggests that the fishermen are either able to avoid the species if they wish or that pinks were, for some reason, less vulnerable in these areas. The much greater representation of pinks in the troll landings data compared with the log book data (Table 3) suggested that vessels reporting catch in the log book program from areas 21-24 simply were not fishing for pink salmon. Areas 25-27 had the highest overall release rate, in keeping with the high capture rate in this region.

Catch of pink salmon during 1982 was considerably lower than it was in 1981 and 1983 (Table 7). Also, during 1982 the catch was apparently concentrated in the north coast. Catch was greatest during June in areas 1-5 rather than July, however, although maximum catch rates were similar to those observed in these areas in 1981 and 1983 (Tables 6, 7). Variation in catch

rate between months, between areas and the area x month interaction were all significant (Table 7). The interaction arose, as in 1981 and 1983, from differences in seasonal pattern of catch rates among fishing areas. The differences were reminiscent of those observed in 1981 and 1983, but rates of capture were so low that any comparison is unwarranted.

Release rates for pink salmon in 1982 were also very low (Table 7). Differences between areas, and the area x month interaction were statistically significant (Table 7), but these differences essentially reflect the fact that releases were recorded in some areas, but not in others.

Differences in distribution of catch between even and odd years may be explained by differences in the relative abundance of pink salmon brood lines in different parts of the coast. Pink salmon captured off Vancouver Island are, presumably, of Fraser River origin, and these stocks are very strong in odd years but rare in even years. Pink salmon captured in the North and Central coasts are from Central, North coast, Queen Charlotte Islands, and southeastern Alaskan stocks, which are abundant in both even and odd years.

Catch-per-hour of Sockeye Salmon Kept and Released

Like pink salmon, the catch of sockeye was strongly seasonal since the fishery intercepts maturing fish migrating back to the spawning rivers. In fact the catch was even more strongly seasonal than the pink catch, virtually none being captured before July and after August (Table 8). In part this was due to the fact that few sockeye were captured in areas other than 25-27, but even on parts of the coast where few were captured the timing of capture was mainly August (Table 8). Nevertheless, the data still show a strong area x month interaction, presumably a result of differences in the relative catch rates between July and August in the different fishing areas.

Relatively few sockeye were released, and release rates tended to reflect capture rates except that the release rate for July exceeded the release rate for August whereas the capture rates were reversed in these two months (Table 8). The significant interaction in the release rate data again presumably arises from the small differences in seasonal pattern of release rate among areas, since most areas had maximum releases in July (Table 8).

Catch of Chum Salmon

Very few chum were caught by trollers in any year (Table 9). Catch rates were comparatively high in areas 25-27 during all three years. During 1981 and 1983 catches were also high in the north and central coast, whereas in 1982 catches were high off central Vancouver Island.

Variation in Catch Rates Between Years

Emphasis in this analysis has so far been on seasonal and regional variation in catch rates, treating years as replicates. This was to highlight variation which would not be masked by year to year differences in catch rates. As I have shown, much of the variation in catch rates is attributable

to seasonal and regional differences. Nevertheless, there were also differences in catch rate between years (Table 10). For example, 1981 and 1982 were years of relatively high catch rate for legal sized chinook (0.661 and 0.694 per hour respectively), whereas in 1983 catch rate was low (0.483 per hour). Catch rate for undersized chinook, on the other hand, was high in 1981 (0.661 per hour) but low in 1982 and 1983 (0.454 and 0.392 per hour respectively). It is tempting to speculate that the low capture rate of undersized chinook in 1982 reflected poor recruitment, and that this contributed to the low capture rate of legal sized chinook in 1983. The low capture rate of undersized chinook in 1983, however, was not followed by a low capture rate of legal sized fish in 1984 (Jordan and Lapi 1985). In part, the lower average rate of capture in 1983 may have been due to the greater amount of log book data from the north coast in that year.

Capture rate of legal coho was significantly lower in 1981 (2.441 per hour) than in 1982 or 1983 (3.143 and 2.917 per hour respectively). Capture rates of coho that were released after capture reflect mainly captures before the season opened in July. These rates were highest in 1981 (0.596 per hour) and lowest in 1982 (0.319 per hour) and the differences between all years were significant. Capture rates for pink salmon did not differ significantly between 1981 and 1983 (1.157 and 0.902 respectively), but were much lower in 1982 (0.073). The lower capture rates in 1982 reflect the absence of Fraser River pinks in even years since most of the pinks landed in odd years were fish on route to the Fraser River. Capture rates for sockeye were significantly higher in 1982 (1.441 per hour) than in 1981 or 1983 (0.025 and 0.031 respectively). The high catch of sockeye in 1982 reflects the strong run of sockeye to the Fraser system in that year, many of which were intercepted by trollers in areas 25-27 (Table 8).

Sex Composition of the Chinook and Coho Catch

Most of the chinook landed, and a subsample of the coho, were identified as to sex by the fishermen. In almost all instances, females outnumbered males in the catch (Tables 11, 12). For chinook, females were significantly more numerous than males in each year of the study, however, there were no significant differences in proportion of females between months or between fishing areas (Table 11). Overall, females comprised 53.6% of the chinook catch.

For coho, females were also significantly more numerous than males in each year of the study, and the proportion of females also varied significantly among areas ($F = 4.9$, $P < 0.05$). Females comprised 63.4% of the catch in the north coast (areas 1-5), and this percentage declined progressively to the south so that in area 21 only 45.3% of the catch was female (Table 12). Overall, females comprised 54.7% of the coho catch.

Females were expected to outnumber males in the catch of chinook because females mature at an older age than males in this species. Thus, female chinook are at sea longer and are subject to greater exploitation than males. The data are, therefore, consistent with expectations for chinook. A significant difference in the abundance of males and females in the coho catch was not expected. Some coho males do mature as jacks after a single summer at sea but, unless the occurrance of jack coho is much more common than hitherto

supposed, jacking cannot account for the high percentage of females in the coho catch. Nor can the occurrence of jacks account for the higher percentage of female coho in the north coast. It seems likely that females are at greater risk of capture relative to their abundance than males for some, as yet unknown, reason.

Size Composition of the Chinook Catch

The size composition of the chinook catch varied considerably among the fishing areas (Fig. 2). In general, chinook were largest in the north and central coasts and smaller off the west coast of Vancouver Island (Table 13). All size frequency distributions show negative skew, with the exception of the catch in areas 1-5 in 1982 and 1983, and the dominance of fish just above the legal size was very marked in area 21 (Fig. 2). There was quite a marked decline in average size of fish from the north to the south end of Vancouver Island with chinook from area 25-27 averaging 96 mm longer than chinook from area 21 (Table 13). This was not just a consequence of different age compositions in the catch from different regions, as similar trends in size were evident within age classes (Table 13). Within each age class the fish sampled by log book trollers were somewhat larger than those sampled from the landed catch by Ball and Godfrey (1968a, b, 1969, 1970) in the 1960's.

Female chinook were larger than males in the catch from all regions, and the difference in size was significant in the north and central coasts and off northern Vancouver Island (average difference in size 31-44 mm), but the difference was small and not significant off central and southern Vancouver Island (average difference in size 2-5 mm)(Table 14). Trends in size with fishing area were consistent among the sexes, and within ages for each sex (Table 13). The trend to increasing size from southern to northern British Columbia was also evident in the sizes reported by Ball and Godfrey (1968a, b, 1969, 1970).

Seasonal changes in mean length were not consistent among fishing areas. Average length of chinook aged 0.2 remained relatively constant over the fishing season, although there were weak increasing and decreasing trends in length in some areas (Fig. 3; Table 13). This presumably was because only a fraction of this age class was of legal size, and new recruits were growing into the legal size fraction throughout the summer. Average length of chinook aged 0.3 increased only slightly, if at all, in the north and central coasts, and at the north end of Vancouver Island from April to September. Fish captured in areas 23 and 24 increased rather dramatically in size from the end of May until the end of July, then declined in size in August and September. Chinook captured in area 21 increased slightly in size from the end of April until the end of July, increased dramatically in size in August, but declined in size in September (Fig. 3; Table 13). Godfrey (1969) observed a similar seasonal pattern of changing size in fish captured off the west coast of Vancouver Island in the 1960's. Age 0.4 chinook increased in length in the north coast, with some fluctuations, from April to September. This age class decreased in length until July in the central coast, and then increased in length in August and September. Off northern and southern Vancouver Island age 0.4 chinook showed no consistent change in size with season, but in some months the fish landed were considerably larger than those landed in most months (Fig. 3; Table 13). Off central Vancouver Island chinook aged 0.4

generally increased in length as the season progressed, but were much larger than expected in August.

Stream type fish aged 1.2 increased in size as the season progressed in areas 1-5 whereas fish aged 1.3 and 1.4 fluctuated in size 5-15 cm without any seasonal trend (Fig. 4; Table 13). Comparatively few stream-type chinook were captured in the central coast, and no clear trends in size were evident. In areas 25-27 chinook aged 1.2 decreased in size between April and May, then increased steadily in size whereas chinook aged 1.3 decreased in size throughout the fishing season. Off central and southern Vancouver Island chinook aged 1.2 showed no clear trend in size but chinook aged 1.3 increased in size for most of the season (Fig. 4; Table 13). Too few chinook aged 1.4 were captured to permit description of size trends.

Size Composition of the Coho Catch

Coho salmon landed also differed in size among fishing areas. Those captured in the north coast were the largest, followed in descending order by those landed in areas 25-27, areas 6-12, areas 23-24 and area 21 (Table 15). Overall differences in average length among areas were significant ($F = 50.7$, $P < 0.001$). The difference in average length between area 21 and areas 1-5 was about 90 mm, compared with about 110 mm for chinook. The coho were, on average, much smaller than the chinook so that the proportional difference in size between fish caught in the south and the north was about the same for the two species (coho from area 21 were only 85% as large as those from areas 1-5). Coho also increased in size from south to north along the west coast of Vancouver Island. Fish captured in area 21 averaged 568 mm in fork length compared with 643 mm for those captured in areas 25-27 (coho from area 21 were 88% as large as those captureed in areas 25-27). Again, this difference was proportionately equal to the difference in size of chinook between the same areas (Table 15).

Female coho were, on average, smaller than male coho in all fishing areas, but the difference was only significant in the north coast (Table 15). Variation in size among fishing regions was consistent among the sexes (Table 15).

Coho from all fishing areas increased in size as the fishing season progressed (Fig. 5). The average rate of change in length ranged from 0.72 mm/d to 1.23 mm/d among areas and overall averaged about 1 mm/d. Rates of change in size did not differ among males and females.

Age Composition of the Chinook Catch

The chinook catch from all areas was dominated by fish aged 0.2 and 0.3 (Table 16). Fish aged 0.3 were more important in the north and central coasts whereas fish aged 0.2 were more important off Vancouver Island. Other age categories were minor components of the catch. Stream type chinook (aged 1.) made up between 8 and 25% of the catch, being most abundant in the north coast, and least abundant in area 21 (Table 16).

Seasonal and regional variation in age composition was statistically

significant (Table 17). Mean total age of all chinook captured ranged from a high of 4.02 yrs in the north coast to a low of 3.28 years in area 21 ($F = 36.15$, $P < 0.0001$). Seasonally, mean age at first increased from 3.58 yrs in April to 3.69 yrs in June, then declined to 3.36 yrs in September ($F = 2.49$, $P < 0.044$). The interaction between months and areas was not significant overall. Within life history types, these same patterns of age variation between areas and months were apparent, but the significance of the variation differed somewhat (Table 17). The variation between months was not significant among ocean type fish whereas the area by month interaction was just significant ($F = 1.81$, $P < 0.048$). The interaction occurred because the pattern of changing age with season was different in the north coast compared with the other fishing areas. In the north coast age declined from April to July then increased again whereas in the other areas age was either continuously high from April to July, or increased slightly over these months, after which age declined (Table 17). Among stream type chinook there was some fluctuation in mean age among months, but age generally declined with time ($F = 4.84$, $P < 0.002$).

Single degree of freedom tests revealed that, overall, chinook captured in the north coast were older than in any other region. Chinook captured in the central coast and off northwest Vancouver Island were significantly younger than those in the north coast, but were also singificantly older than those off central and southwestern Vancouver Island. Chinook captured off central and southwestern Vancouver Island were significantly younger than those captured elsewhere. Similarly, chinook captured prior to August were significantly older than those captured in August and September. Within life history types similar regional patterns of variation in age are apparent, except that the ages of stream type fish in the north coast were not distinguishable from the ages of those in the central coast and off northwest Vancouver Island. The regional variation in mean age of chinook, and the age composition in different regions of the coast were similar to those observed by other investigators (Healey 1982, 1983; Godfrey 1969; Ball and Godfrey 1968a, b, 1969, 1970).

In the above analyses, years were used as replicates. Overall, the mean age of chinook was significantly greater in 1983 (3.66 y) than in 1982 (3.47 y) (Table 18). Within life history types, however, chinook captured in 1983, although older than those captured in 1982, were not significantly older. Thus, it appears that variation in age among years, at least for 1981-1983, was not very dramatic.

Diets of Chinook and Coho

Because of potential problems with identification of diet items by the fishermen and observers, only a very simple description of the diets of the two species will be presented. For chinook, herring was the dominant diet item in all areas and most years (Fig. 6). Little else was observed in their stomachs in area 21, although in 1982 and 1983 euphausiids contributed significantly to the diets of 15-20% of the fish. In all other areas sandlance were an important diet item, being more important than herring in some instances (Fig. 6). Euphausiids were also moderately important in areas 23-24 and squid in areas 6-12 (Fig. 6).

Coho diets appeared to be somewhat more varied than chinook diets, in the sense that items other than herring played a more important role in coho diets. Herring was, however, still their most common food (Fig. 7). No coho were examined from the north coast or from area 21 in 1981, but herring was the most common food of coho in all other times and areas with the exception of two instances. In the central coast in 1981 squid were more important, and in areas 23-24 in 1983 euphausiids were more important. Sandlance were important components of coho diet at some times in all locations, and euphausiids were important in all years along the west coast of Vancouver Island. Anchovies and small rockfishes also contributed modestly to coho diets at some times (Fig. 7). Chinook and coho diets were well correlated in the sense that they fed on the same kinds of organisms, and individual diet items tended to be high or low in both species in the same areas and years (Fig. 6, 7). Coho, however, appeared to eat more invertebrate foods, and to take relatively more of the less common diet items.

DISCUSSION AND MANAGEMENT IMPLICATIONS

The analysis presented in this report presumes that the catch and biological data for individual species are representative of the troll fleet as a whole, even though the overall catch composition for trollers participating in the log book program was somewhat different from that for the whole fleet. It also presumes that characteristics of the catch in a particular area reflect characteristics of the fish population in that area rather than characteristics of the fishermen reporting from the area. Neither of these assumptions may be true, and any interpretations of the log book data should be viewed in that light.

Certain characteristics of the chinook catch changed in a systematic way from the southern to the northern British Columbia coast. The April to June period, during which time only chinook could legally be landed, may be most representative of the characteristics of chinook populations, since catches during this time period are not influenced by the availability of other species. During these months catch per hour increased in the north and central coasts, but decreased off southern and central Vancouver Island. Catch per hour did not change systematically off northern Vancouver Island. Similarly, the catch per hour of shakers increased in the north and central coasts, decreased off southern and central Vancouver Island, and was variable off northern Vancouver Island. Over all months the proportion of females in the catch increased from south to north along the coast as did the mean size of chinook landed, the mean age of chinook landed, and the proportion of stream-type fish in the catch. Similar patterns of variation in age, size, and contribution of stream type fish have been noted in the past (Healey 1982; Milne 1964; Godfrey 1969, Ball and Godfrey 1968a, b, 1969, 1970) but usually not in as much detail.

The persistence of these patterns of regional and seasonal variation in characteristics of the chinook catch, as evidenced by the significant regional and seasonal differences in these parameters averaged across years,

provide the manager with considerable opportunity to target the fishery on particular components of the chinook population. This opportunity is particularly evident along the west coast of Vancouver Island where regional differences in size and age composition were almost as great as they were along the whole coast. In particular, there appears to be a good opportunity to prevent unwanted mortality of undersized fish by closing area 21 to trolling. The portion of the fleet that operates in area 21 could be moved north into area 23-24 with little loss in catch rate of legal sized fish (0.16 chinook per hr), a considerable increase in the mean size of fish landed (3 cm), and a considerable saving in shaker losses (1.00 shakers per hr). Since there is some evidence of a northward dispersal of chinook with age during their marine life, chinook not captured in area 21 are likely be be available for capture later in the season, and at a larger size, in areas 23 and 24.

Catch per hour of legal sized and shaker chinook was positively correlated during the April to June time period, but the relationship appeared curvilinear rather than linear (Fig. 8). Catch of legal sized fish was proportionately higher than catch of shakers until the catch rate was about 0.8 fish per hour, after which the catch of legal sized fish was lower than the catch of shakers (Fig. 8). The reason for this relationship apparently has to do with the high contribution of fish aged 0.2 to the catch. Since this is the most abundant age class, and only a portion of the age class is of legal size, high catches of both legal and shaker sized fish are associated with high catches of this age class.

Mean length of chinook landed and catch per hour tended also to be negatively correlated, so that when catch rate was low the average size of fish landed was high (Fig. 9). Another way to interpret these data is that the central and northern coasts and the north coast of Vancouver Island are characterized by low catch rate but large fish size whereas the central and southern coasts of Vancouver Island are characterized by high catch rate but small fish size. Although catch rate is much lower in the northern than in southern areas, since the fish are larger in size, landed weight is not proportionately lower in northern than in southern areas. Landed weight per hour is lower in the central and northern coast (Fig. 9), but since more medium and large chinook, which command a higher price, are landed, the value of a days catch may be little different in the north than in the south. Consequently, it should be possible to target the fleet on larger, older, fish without significant loss of income to fishermen, if such a measure were considered desirable. Such targetting would have to take account of stock and age composition in the catch from different areas of the coast to ensure that any redistribution of effort harvested the same stocks at a larger size rather than different stocks.

Based on catch per hour fishing, coho were least abundant off northwestern Vancouver Island and the central coast, and were most abundant off southwestern Vancouver Island. Coho captured incidentally before the season opened were generally most abundant off southwestern Vancouver Island, where landings were subsequently highest. Incidental captures of coho were also rather high in the central coast region, however, where subsequent landings were low. Incidental catch prior to the season opening may not, therefore, be a good indicator of the landings to expect when the season opens. The incidence of shaker coho was generally low after the season opened, but increased dramatically in September as juveniles that had migrated

seaward in the spring became vulnerable to the troll gear. Hooking mortality of these small fish is probably extremely high, and earlier closing of the troll fishery might significantly reduce the non-catch mortality of coho.

The catch rates for legal coho and shaker coho were not well correlated, in contrast to chinook. Nor was there any correlation between the catch rate for coho and the catch rate for chinook during the July to September period. Consequently, it does not appear easy to target the fishery to avoid shaker coho, or to achieve any particular mix of coho and chinook in the catch simply by opening and closing existing statistical areas. Catch rate for coho in area 21 was rather high, suggesting that some opportunities may be lost if this area were closed to conserve chinook. Catch rate for coho in areas 23-24, the most logical area in which to relocate boats fishing in area 21, was higher than in area 21 during July, but dropped off quickly in August and September. If this decline in catch rate reflects a decline in the abundance of coho, then this area may not be able to support more vessels easily. Some of the decline in catch rate for coho in areas 23-24 during August and September may have been due to fishermen targeting on sockeye and pink, something that did not appear to happen in area 21 (Tables 5, 6, 8).

The high percentage of female coho in the catch suggests that this sex is more vulnerable to troll gear. A greater vulnerability of female coho to trollers could exaggerate biased sex ratios in spawning populations, and select for smaller sized females, both of which would reduce the reproductive output of spawning populations. The bias in sex ratio of the catch was not uniform along the coast, but was greatest in the north and least off Vancouver Island. In area 21 the sex ratio was, in fact, biased toward males. It is not at all clear why the sex ratio of the catch from different regions was different.

The increase in size of coho over the summer was continuous and fairly uniform in all regions except area 21. Presumably the increase in size reflects growth, and the persistent size differences between areas together with declining catch rates in all areas over time suggest that the fishery in each area is harvesting from a local pool of fish that is being depleted. Presumably the depletion is a consequence of both fishing and emigration to spawning grounds. In area 21, however, catch rate did not decline in September, and the average size of coho landed in this area increased unexpectedly in the latter half of August and early September. This may indicate a movement of larger coho into this area in late August.

The average length of coho landed from different fishing regions was strongly positively correlated with the size of chinook landed from the same regions. Two possible explanations for this relationship are: 1) The different regions of the coast may have features that, for some reason, make them attractive either to large or to small fish, so that both species become segregated by size by choosing different habitat features. Under this explanation large coho and chinook would have to have similar habitat preferences, as would small coho and chinook. 2) Some regions of the coast may provide better conditions for growth so that the fish that live there grow larger. If we presume that the increase in size of coho over the summer in the different coastal regions is mainly due to growth, then there is no evidence that coho in areas 1-5 grow significantly faster than coho in areas 23-24. Consequently, differences in growth would have to be concentrated in

the first summer of ocean life for this explanation to be acceptable. Additional explanations for the relationship may become apparent when more details of individual stock distributions are known.

Pink and sockeye were captured mainly in areas 25-27, although moderate catches of pink were also made in the north and central coast regions. The sharp drop in coho catch in areas 25-27 in August may reflect a switching of effort from coho to sockeye and pink. There was an apparent drop in the catch rate of chinook in areas 25-27 during August, however. Consequently, there is no evidence that permitting greater harvest of pink and sockeye by trollers would substantially reduce fishing pressure on chinook although it might affect the harvest rate of coho.

The large catches of pink and sockeye in areas 25-27 and their relatively much smaller catch in areas 6-12 and 23-24, which were adjacent fishing regions on the home route of these species to the Fraser River, is perplexing. Note that, for pink salmon, the landing statistics show much greater catch off central and southwestern Vancouver Island than is suggested by the log data records. If the log book records reflect catchability, however, the north end of Vancouver Island may be the typical landfall of these species on their return migration from the ocean feeding grounds. Consequently, they may pool in this area for some time before continuing their rapid homeward migration, and thus be available in large numbers to the local fishery. Alternatively, maturing pink and sockeye may stop feeding rather soon after arriving at the coast, so that they are only vulnerable to the troll gear for a short time after landfall. Pink and sockeye captured further south along Vancouver Island, or in Queen Charlotte Strait, are similar in size or smaller than those landed in areas 25-27, which is consistant with, this latter explanation. Sockeye are vulnerable to troll gear near the Fraser River estuary, however, suggesting that reduced feeding activity is not a sufficient explanation for the low catch of these species off central and southwestern Vancouver Island.

The apparently greater vulnerability of females of both chinook and coho to troll gear poses some potential problems for the manager. Why females, expecially coho females, should be more vulnerable is not at all clear. It may have to do with the females' need to accumulate more surplus energy for egg production, nest defence, etc., than males. Or it may reflect distributional differences that are sex specific. Males may roam further off shore, for example. The change in sex ratio of the coho catch from southern to northern B.C. suggests that differences in distribution of sexes may occur. Alternatively, it may have to do with differences in migratory timing between the sexes. In the case of chinook, the older age of maturity of females may be sufficient to explain the greater abundance of females in the catch. Males of both species might, however, initiate their spawning migration earlier than females, thus leaving the females more available to the offshore troll fishery. Whatever the explanation, greater exploitation of females in the fishery could result in stock declines at exploitation rates lower than those calculated to be sustainable on the basis of recruits per spawner (Hankin and Healey 1986).

The composition of diet of chinook and coho was comparable to that observed by other authors in other years (Pritchard and Tester 1944; Prakash 1962; Healey 1976). Pilchards were important in the diets of these two

species prior to their collapse in abundance. However, since that time, herring, sandlance, euphausiids and squid have dominated their diet in all published studies.

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Table 1. Number of vessels and fishing hours reported each year for each aggregate group of statistical areas. Note that some vessels reported fishing in several statistical area groupings.

Statistical Area Groupings[a]	Year					
	1981		1982		1983	
	Vessels	Hours	Vessels	Hours	Vessels	Hours
North (1-5)	8	1169	3	904	15	15350
Central (6-12)	10	1248	6	1752	8	2199
NWVI (25-27)	11	897	14	2753	7	1474
CVI (23-24)	21	4249	14	9841	9	7942
Swiftsure (21)	6	958	9	1959	7	1475
All areas	35	8503	20	17209	26	28440

[a]NWVI = northwest Vancouver Island. CVI = central Vancouver Island.

Table 2. Regulations affecting the west coast troll fishery during 1981-1983.

1981:

1) The west coast was opened to trolling for salmon, except coho, on 15 April.
2) Area 21 closed to trolling from 15 April to 20 May and from 27 May to 1 July to reduce catch of sub-legal chinook and out of season coho. Parts of area 23 (south bank) were closed for the same reason on April 28 and during 13 June to 1 July.
3) Parts of area 12 closed to trolling, except during net fishery openings, from 15 April to 3 September. Area 11 was also closed to trolling, except during net fishery openings, from 27 August to 30 September. Inside portions of area 3 were closed to trolling, except during net fishery openings, from 3 May to 6 September. The southern portion of area 2W was closed to trolling from 19 June to 1 July, and the western portion of area 1 was closed during 2-7 August.
4) Trolling for coho opened on 1 July.
5) During the month of July in areas 21 to 27 trollers were permitted to retain pinks up to a maximum of 33% (by number) of their combined chinook and coho catch.
6) The trolling season ended on 30 September.

1982:

1) The west coast, with the exception of areas 2E and 2W, was opened to trolling for salmon, except coho, on 15 April. Areas 2E and 2W were opened on 28 May.
2) Areas 1-11 were closed 10-24 June as a conservation measure for chinook.
3) From 23 June in area 3 and 29 June in other central and north coast areas, trolling was from time to time, permitted only during net fishing opening.
4) Areas 9-12 and 21-27 opened for coho fishing 28 June, areas 1-8 opened for coho fishing 1 July.
5) Area 12 was closed to trolling 24-25 August, reopened 27 August but sockeye, pink or chum could not be retained until after 3 September.
6) Areas 21, 11 and 30 were closed to trolling 6 August. Areas 11 and 30 were reopened 19 August. Area 21 remained closed until the end of the season.
7) Troll fishing closed on 24 September in area 9 and on 30 September in all other areas.

1983:

1) The west coast was opened to salmon trolling, except for coho, on 15 April.
2) Three trollers were chartered by the Department of Fisheries and Oceans to monitor the frequency of shakers in areas 21 and 23. Closures of these areas would not be implemented if trollers voluntarily avoided regions of high shaker catch identified by the charter vessels. This measure was successful in reducing undesirable capture of small and out of season salmon.

Table 2 (cont'd)

1983 (cont'd):

3) Areas 1-11 were closed to trolling during 17-30 June as a conservation measure for chinook.
4) Areas 21-27, 11 and 12 were closed to trolling for sockeye and pink salmon on 15 June. Areas 24-27, 11 and 12 were reopened for these species on 25 July.
5) Trolling for coho opened on 1 July in all areas.
6) Area 12 was opened for chum fishing on 3 July. During 15 June to 10 July trolling for sockeye and pink was not permitted in area 12. The area was closed to trolling for sockeye, pink and chum on 3 August and reopened on 26 August. Area 12 was closed to all trolling during 5-7 September but reopened for coho and chinook fishing on 8 September. During 13-30 September trollers were permitted to retain chum salmon only during net fishery openings.
7) Trolling in all areas was closed on 30 September.

Table 3. Percent composition of catch by trollers in different regions of the coast calculated from landings for the whole fleet and from log book records.

		Statistical Area Groupings							
		Areas 1-5		Areas 6-12		Area 21		Areas 23-27	
Year	Species	Landings	Log book	Landings	Log book	Landings	Log book	Landings	Log book
1981	Chinook	16.2	44.7	9.1	15.3	10.6	74.4	8.5	17.8
	Coho	40.2	25.2	22.5	45.4	36.4	23.3	29.8	36.7
	Sockeye	1.4	2.3	2.0	0.6	0.8	0.3	1.0	0.6
	Pink	41.5	25.7	65.9	38.0	52.0	1.8	60.5	44.7
	Chum	0.8	2.0	0.6	1.6	0.2	0.1	0.2	0.1
Total	Catch x 10^3	936	2.1	1637	3.9	269	1.1	4322	20.1
1982	Chinook	23.4	20.9	20.5	30.5	25.1	28.3	11.3	14.2
	Coho	53.1	34.3	56.5	48.6	67.2	71.6	37.5	43.0
	Sockeye	5.2	0.0	13.9	11.4	7.3	0.1	48.7	42.1
	Pink	17.5	44.5	6.8	9.2	0.0	0.0	0.8	0.2
	Chum	0.8	0.2	2.3	0.3	0.4	0.0	1.6	0.6
Total	Catch x 10^3	743	2.4	361	2.4	148	5.6	4474	64.1
1983	Chinook	12.5	13.0	4.9	7.5	13.6	30.0	9.3	15.2
	Coho	56.3	48.8	23.0	46.0	76.2	66.4	52.3	71.3
	Sockeye	0.5	1.2	5.5	2.6	0.0	0.0	9.7	0.3
	Pink	30.0	36.3	66.0	43.2	10.0	4.6	28.5	13.2
	Chum	0.8	0.7	1.0	0.7	0.2	0.0	0.2	0.0
Total	Catch x 10^3	1304	43.7	2054	8.9	284	3.3	3733	37.0

Table 4. Catch-per-hour fishing for chinook in each fishing region each month. Values are means for 1981-1983. Analysis of variance result is shown below tabular data.

Statistical Areas	Month						All Months
	April	May	June	July	August	September	
Chinook of legal size							
1-5	0.251	0.390	0.543	0.292	0.710	0.506	0.464
6-12	0.114	0.422	0.522	0.409	0.273	0.038	0.371
21	1.243	1.126	0.846	0.161	0.296	0.211	0.742
23-24	1.056	1.043	0.650	0.446	0.693	0.610	0.731
25-27	0.423	0.303	0.456	0.244	0.260	0.459	0.303
All Areas	0.912	0.772	0.608	0.361	0.544	0.410	0.565
Chinook smaller than legal size							
1-5	0.061	0.140	0.226	0.157	0.111	0.064	0.142
6-12	0.224	0.323	0.353	0.336	0.267	0.483	0.335
21	1.750	2.077	1.113	1.059	1.121	1.829	1.675
23-24	0.823	0.739	0.373	0.296	0.401	1.164	0.542
25-27	0.174	0.212	0.091	0.168	0.148	0.125	0.152
All Areas	0.826	0.671	0.381	0.252	0.254	0.345	0.457

Analysis of Variance Table

Source	df	F	P>F
Legal sized chinook			
Statistical Areas	4/4677	69.7	0.0001
Months	5/4677	27.8	0.0001
Area x month	20/4677	22.4	0.0001
Sub-legal sized chinook			
Statistical Areas	4/4677	240.0	0.0001
Months	5/4677	19.6	0.0001
Area x month	20/4677	12.3	0.0001

Table 5. Catch-per-hour fishing for coho in each fishing region each month. Coho released are either below legal size or out of season. Values are means for 1981-83. Analysis of variance result is shown below tabular data.

Statistical Areas	Month						All Months
	April	May	June	July	August	September	
Coho landed							
1-5	0.0	0.0	0.0	3.78	1.19	0.229	2.28
6-12	0.0	0.0	0.0	2.34	1.70	1.07	1.90
21	0.0	0.0	0.0	5.48	3.24	3.38	3.63
23-24	0.0	0.0	0.0	5.48	3.06	2.03	4.20
25-27	0.0	0.0	0.0	4.07	0.840	0.618	1.91
All areas	0.0	0.0	0.0	4.34	1.80	1.61	2.92
Coho released							
1-5	0.206	0.316	0.773	0.042	0.113	0.092	0.235
6-12	1.18	0.382	0.578	0.067	0.051	0.627	0.292
21	1.60	1.06	0.782	0.046	0.093	1.07	0.973
23-24	0.785	0.971	0.883	0.046	0.058	0.561	0.521
25-27	0.088	0.085	0.792	0.031	0.020	0.130	0.116
All areas	0.803	0.698	0.791	0.046	0.067	0.520	0.407

Analysis of Variance

Source	df	F	P>F
Coho landed			
Statistical Areas	4/2624	44.7	<0.0001
Months	2/2624	89.8	<0.0001
Area x Month	8/2624	5.2	<0.0001
Coho released			
Statistical Areas	4/4677	29.17	<0.0001
Months	5/4677	45.52	<0.0001
Area x Month	20/4677	8.57	<0.0001

Table 6. Catch-per-hour fishing for pink salmon in each fishing region each month. Values are means for 1981 and 83. Analysis of variance result is shown below tabular data.

Statistical Areas	Month						All Months
	April	May	June	July	August	September	
Pink landed							
1-5	0.0	0.002	0.052	2.580	1.103	0.332	1.062
6-12	0.0	0.0	0.001	0.960	2.942	3.675	1.482
21	0.0	0.009	0.004	0.156	0.000	0.277	0.071
23-24	0.010	0.003	0.017	0.418	0.928	0.374	0.294
25-27	0.000	0.003	0.007	0.532	8.500	0.584	3.564
All areas	0.005	0.003	0.028	1.500	2.273	0.742	0.965
Pink released							
1-5	0.0	0.0	0.006	0.163	0.123	0.011	0.079
6-12	0.0	0.017	0.0	0.315	0.006	0.0	0.093
21	0.083	0.054	0.013	0.564	0.231	0.002	0.073
23-24	0.148	0.065	0.046	0.471	0.106	0.0	0.182
25-27	0.123	0.0	0.397	2.550	0.052	0.0	0.664
All areas	0.098	0.032	0.033	0.442	0.094	0.006	0.155

Analysis of Variance Table

Source	df	F	P>F
Pink Landed			
Statistical Areas	4/3179	10.86	0.0001
Months	5/3179	21.44	0.0001
Area x Month	20/3179	28.56	0.0001
Pink Released			
Statistical Areas	4/3179	18.19	0.0001
Months	5/3179	52.09	0.0001
Area x Month	20/3179	25.93	0.0001

Table 7. Catch-per-hour fishing for pink salmon in each fishing region each month in 1982. Analysis of variance result is shown below tabular data.

Statistical Areas	Month						All Months
	April	May	June	July	August	September	
Pink landed							
1-5	-	0.0	2.38	1.18	-	-	0.979
6-12	-	0.0	0.022	0.114	0.835	0.146	0.135
21	0.0	0.0	0.0	0.0	0.0	0.0	0.0
23-24	0.001	0.0	0.007	0.004	0.001	0.0	0.003
25-27	0.0	0.0	0.008	0.021	0.042	0.0	0.027
All areas	0.001	0.0	0.155	0.101	0.081	0.014	0.073
Pink released							
1-5	-	0.0	0.004	0.0	-	-	0.001
6-12	-	0.008	0.014	0.0	0.024	0.0	0.009
21	0.0	0.0	0.0	0.0	0.0	0.0	0.0
23-24	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25-27	0.0	0.0	0.0	0.021	0.0	0.008	0.007
All areas	0.0	0.001	0.003	0.004	0.002	0.001	0.002

Analysis of Variance Table

Source	df	F	P>F
Pink Landed			
Statistical Areas	4/1472	69.5	0.0001
Months	5/1472	11.85	0.0001
Area x Month	16/1472	14.26	0.0001
Pink Released			
Statistical Areas	4/1472	3.03	0.02
Months	5/1472	0.42	0.83
Area x Month	16/1472	2.58	0.0006

Table 8. Catch-per-hour fishing for sockeye salmon in each fishing area each month. Tabular values are means for 1981-83. Analysis of variance result is shown below tabular data.

Statistical Areas	Month						All Months
	April	May	June	July	August	September	
Sockeye landed							
1-5	0.0	0.0	0.0013	0.0528	0.0841	0.0110	0.0361
6-12	0.0	0.0	0.0007	0.0478	0.3965	0.0375	0.1041
21	0.0	0.0	0.0	0.0447	0.0199	0.0007	0.0038
23-24	0.0	0.0	0.0030	0.5341	0.8955	0.0014	0.2817
25-27	0.0	0.0	0.0059	1.7118	6.9054	0.0021	3.4423
All areas	0.0	0.0	0.0021	0.4192	1.7952	0.0079	0.4788
Sockeye released							
1-5	0.0	0.0	0.0	0.0001	0.0011	0.0	0.0003
6-12	0.0	0.0	0.0	0.0	0.0007	0.0	0.0002
21	0.0	0.0	0.0	0.0620	0.0086	0.0	0.0037
23-24	0.0	0.0004	0.0002	0.0031	0.0016	0.0	0.0012
25-27	0.0	0.0	0.0	0.0414	0.0009	0.0	0.0114
All areas	0.0	0.0001	0.0	0.0067	0.0014	0.0	0.0023

Analysis of Variance Table

Source	df	F	P>F
Sockeye Landed			
Statistical Areas	4/4706	24.89	<0.0001
Months	5/4706	43.23	<0.0001
Area x Month	20/4706	40.00	<0.0001
Sockeye Released			
Statistical Areas	4/4706	10.22	<0.0001
Months	5/4706	29.33	<0.0001
Area x Month	20/4706	10.57	<0.0001

Table 9. Catch (number landed) and catch per hour of chum salmon by trollers fishing in different areas in 1981, 82 and 83.

Year	Measure	Area				
		1-5	6-12	25-27	23-24	21
1981	Catch	86	22	24	2	1
	Catch/h	0.0736	0.0176	0.0268	0.0005	0.0010
1982	Catch	5	8	176	186	1
	Catch/h	0.0055	0.0046	0.0639	0.0189	0.0005
1983	Catch	316	63	31	5	0
	Catch/h	0.0206	0.0286	0.0210	0.0006	

Table 10. Variation in catch rate (±SE) between years for each species (except chum).

	Year		
	1981	1982	1983
Chinook			
Kept	0.661 (0.024)	0.694 (0.018)	0.483 (0.010)
Released	0.661 (0.035)	0.454 (0.020)	0.392 (0.016)
Coho			
Kept	2.441 (0.137)	3.143 (0.130)	2.917 (0.090)
Released	0.596 (0.040)	0.319 (0.020)	0.399 (0.021)
Pink			
Kept	1.157 (0.163)	0.073 (0.017)	0.902 (0.049)
Released	0.090 (0.012)	0.002 (0.007)	0.176 (0.016)
Sockeye			
Kept	0.025 (0.005)	1.441 (0.111)	0.031 (0.003)
Released	0.000 (0.000)	0.0003 (0.0001)	0.0038 (0.0009)

Table 11. Percentage of female chinook in the troll catch by month and fishing region. Analysis of variance table for analysis on square root transformed variables, and the X^2 test of hypothesis that sex ratio is 1 female:1 male for each year.

Statistical Areas	Month						All Months
	April	May	June	July	August	September	
1-5	56.7	62.1	55.6	51.0	45.3	50.8	54.9
6-12	100.0	50.1	53.1	48.2	41.0	94.3	55.1
21	48.9	51.3	57.2	79.2	37.1	46.2	51.8
23-24	53.4	51.1	52.7	56.2	58.0	52.0	53.9
25-27	61.5	41.0	60.0	52.8	52.2	48.8	53.0
All Areas	58.9	51.1	55.7	55.9	46.9	53.7	43.6

Analysis of Variance Table

Source	df	F	P>F
Months	5/48	2.00	>0.05
Areas	4/48	1.29	>0.05
Month x Area	20/48	1.75	>0.05

X^2 Analysis

1981	H_o; female/ male = 1.0;	female = 2999	male = 2804	X^2 =	6.48	P<0.01
1982	" " ;	"	6043	"	5312	"	47.06	<0.001
1983	" " ;	"	7217	"	6943	"	5.30	<0.05

Table 12. Percentage of female coho in the troll catch by month and fishing region. Analysis of variance table for the analysis on square root transformed percentages, and the X^2 test of hypothesis that sex ratio is 1 female:1 male for each year.

Statistical Areas	Month						All Months
	April	May	June	July	August	September	
1-5			78.1	55.4	56.8	64.9	63.4
6-12			44.0	56.1	55.2	65.9	55.5
21			39.1	37.8	50.3	50.9	45.3
23-24			51.6	54.1	56.5	54.2	54.6
25-27			51.3	55.5	57.1	51.6	54.7
All Areas			57.0	52.8	55.3	55.4	54.7

Source	df	F	P>F
Months	2/21	0.98	>0.05
Areas	4/21	4.19	>0.01
Month x Area	12/21	1.27	>0.05

X^2 Analysis

1981	H_0; female/ male = 1.0;	female =	3678	male =	2951	X^2 = 79.7	P<0.001
1982	" "	"	6584	"	5494	" 98.4	<0.001
1983	" "	"	5822	"	4683	" 123.5	<0.001

Table 13. Mean fork length (±SE) (mm) of male and female chinook of different ages captured in each fishing region. Data are averages for 1981-83. There were no significant differences between years. Lengths with no standard error are for a single fish.

Fishing Area	Sex	April 15-30	May 1-15	May 16-31	June 1-15	June 16-30	July 1-15	July 16-31	August 1-15	August 16-31	September 1-15	September 16-30
Age 0.2												
1-5	M	668(12)	679(9)	689(7)	698(5)	693(5)	701(6)	689(4)	697(5)	683(5)	697(10)	684(15)
	F	694(26)	726(25)	689(9)	693(8)	691(8)	695(8)	687(6)	694(9)	760(20)	708(31)	690(31)
6-12	M		724(8)	720(8)	718(12)	728(11)	710(8)	716(10)	711(9)	718(7)	709(15)	695(65)
	F	620	732(11)	727(10)	724(15)	703(32)	706(14)	707(21)	694(10)	680(10)		710
21	M	663(3)	674(5)	662(3)	672(4)	677(5)	660(30)	664(14)		663(9)	669(5)	672(10)
	F	659(3)	675(5)	657(2)	660(4)	673(5)	679(27)	642(25)		672(9)	678(7)	676(11)
23-24	M	692(2)	688(2)	674(2)	683(2)	692(4)	699(4)	715(4)	707(4)	690(4)	682(4)	705(8)
	F	682(2)	676(2)	665(2)	674(2)	681(4)	694(4)	696(3)	690(3)	684(3)	671(3)	680(5)
25-27	M	731(13)	730(15)	700	713(13)	737(10)	716(12)	698(9)	692(10)	705(9)	715(18)	
	F	715(20)	720(17)	660	688(11)	745(11)	735(20)	690(13)	736(13)	735(21)	687(15)	
Age 0.3												
1-5	M	811(18)	836(12)	825(6)	832(9)	792(12)	836(8)	821(9)	822(7)	825(8)	811(15)	810(27)
	F	786(11)	828(9)	819(4)	819(6)	812(8)	843(5)	821(6)	850(4)	846(5)	827(16)	819(14)
6-12	M		820(16)	830(10)	843(10)	855(16)	822(12)	833(19)	803(4)	841(20)	755(15)	
	F	780	793(12)	810(9)	822(9)	850(11)	847(10)	862(9)	825(12)	828(18)	900(10)	
21	M	717(11)	720(14)	707(9)	729(14)	743(25)		690		775(155)	843(87)	
	F	711(7)	752(15)	724(9)	734(9)	750(12)	820(61)	783(33)		940(10)	820(18)	690
23-24	M	742(5)	736(4)	735(5)	759(6)	780(8)	805(9)	837(7)	824(12)	894(12)	855(27)	707(25)
	F	736(4)	739(4)	734(4)	760(4)	774(6)	791(6)	815(5)	806(7)	806(9)	737(17)	755(31)
25-27	M	830(12)	801(21)	900	824(38)	861(26)	822(17)	850(14)	857(28)	819(19)	770	
	F	776(13)	805(18)		797(19)	824(11)	847(10)	819(16)	827(12)	844(16)	865(25)	
Age 0.4												
1-5	M	987(38)	945(21)	905(18)	974(20)	851(33)	964(25)	968(22)	924(24)	927(36)	910	1030(1)
	F	859(17)	938(11)	915(7)	921(9)	900(20)	915(10)	934(10)	942(9)	925(10)	928(13)	958(21)

Table 13 (cont'd)

Fishing Area	Sex	April 15-30	May 1-15	May 16-31	June 1-15	June 16-30	July 1-15	July 16-31	August 1-15	August 16-31	September 1-15	September 16-30
6-12	M		1003(12)	920(70)	929(35)	1020	870(47)	929(45)	960(30)	990	1080	
	F		942(18)	923(22)	917(14)	908(12)	913(23)	899(22)	968(38)	980(31)		
21	M	700(10)		700(30)								
	F	810	740	748(36)	910	800		720				
23-24	M	839(31)	807(64)	805(32)	779(36)	880(40)	815(125)	870	938(43)	923(7)		
	F	795(42)	798(15)	763(20)	814(25)	837(13)	839(33)	852(18)	901(18)	920(9)	860	
25-27	M		800					760	815(35)	783(105)	1000	
	F	850	907(28)			935(115)	900(41)	927(16)	862(34)	949(19)	932(29)	
Age 1.2												
1-5	M	698(37)	752(20)	731(12)	723(9)	727(7)	775(14)	761(15)	790(18)	751(16)	330	757(59)
	F	747(20)	750(12)	756(11)	751(11)	740(8)	743(9)	753(13)	774(14)	782(44)	755(5)	825(5)
6-12	M		768(30)	781(31)	801(26)	752(19)	773(36)	793(24)	818(54)	720		
	F		775(38)	720(15)	749(22)	730(21)	772(10)	810(12)	737(49)	770(35)		
21	M	695(19)	687(10)	678(9)	716(17)	700(18)						690
	F	670(12)	667(11)	671(9)	698(10)	688(10)						
23-24	M	696(8)	701(7)	690(7)	725(8)	696(12)	759(18)	735(15)	732(25)	747(39)	705(27)	745(55)
	F	712(7)	689(6)	696(7)	720(8)	721(12)	735(11)	740(12)	719(15)	731(15)	714(20)	715(33)
25-27	M	795(3)	730		690	715(55)	710(10)	774(14)	730(35)	773(21)		
	F	713(32)	670(15)		700	775(17)	685(5)	765(25)	825(20)	776(22)	795(55)	
Age 1.3												
1-5	M	928(20)	896(37)	906(14)	899(15)	886(50)	894(19)	902(17)	854(39)	904(24)	945(75)	980
	F	914(27)	849(17)	877(11)	819(8)	883(15)	872(8)	879(17)	887(15)	921(18)	940(40)	932(18)
6-12	M		965(45)	845(25)	868(27)				810(10)	690		
	F		863(31)	892(25)	877(15)	960(20)	877(29)					
21	M	670		760	920	635(25)						
	F	815(55)	760(36)	824(12)	835(25)	760						
23-24	M	731(37)	754(20)	754(29)	755(21)	804(37)	868(27)	914(49)	857(58)	900(50)		
	F	760(60)	792(22)	833(23)	806(15)	841(36)	867(12)	853(10)	780(49)	815(45)		
25-27	M	885(5)	845(25)			870(80)	860	905(85)	860(70)			800
	F	870(34)	895(15)			820	893(31)	887(41)	840	815(65)		

Table 13 (cont'd)

Fishing Area	Sex	April 15-30	May 1-15	May 16-31	June 1-15	June 16-30	July 1-15	July 16-31	August 1-15	August 16-31	September 1-15	September 16-30
Age 1.4												
1-5	M			1032(38)	1081(16)		963(14)	1000	860	860		
	F	987(41)	932(19)	964(25)	1002(15)		969(15)		914(23)	931(44)	1045(5)	
6-12	M							1000			1020	
	F		940		885(5)							
21	M											
	F											
23-24	M			800	880							800
	F		780		770	960						
25-27	M					760	1040				820	950
	F					925(5)					990	

Table 14. Mean fork lengths mm (± SD) of chinook captured in the various fishing areas each year.

Area	Sex	1981	1982	1983	All Years	Combined sexes
1-5	M	747 (10.6)	812 (11.2)	777 (11.1)	779	
	F	789 (10.6)	850 (11.2)	831 (11.1)	823	801
6-12	M	774 (12.0)	774 (9.5)	766 (9.1)	771	
	F	803 (12.0)	804 (9.5)	798 (9.1)	802	786
21	M	683 (5.9)	674 (6.4)	676 (6.3)	678	
	F	693 (5.9)	678 (6.4)	679 (6.3)	783	680
23-24	M	699 (7.3)	712 (8.1)	720 (8.5)	710	
	F	700 (7.3)	716 (8.1)	720 (8.5)	712	711
25-27	M	772 (8.6)	761 (9.9)	744 (10.4)	759	
	F	799 (8.6)	791 (9.9)	787 (10.4)	792	776

Table 15. Mean length (± SE) of coho captured by trollers fishing in different areas during 1981-83.

Area	Sex	July		August		September		All
		1-15	16-31	1-15	16-31	1-15	16-30	Months
1-5	F	618.7(±1.5)	639.0(±1.3)	643.3±(1.9)	650.5±(2.4)	670.1±(4.4)	669.9±(8.0)	648.5
	M	621.8(±2.0)	639.6(±2.2)	650.9±(3.0)	669.8±(3.8)	694.1±(8.4)	712.4±(13.5)	664.8
6-12	F	583.3(±2.5)	606.7(±2.4)	632.3±(2.9)	649.5±(3.4)	639.1±(7.2)	645.6±(6.3)	626.1
	M	575.5(±2.9)	603.1(±3.6)	614.0±(4.2)	649.2±(5.2)	659.6±(10.6)	695.8±(10.3)	632.9
21	F	537.9(±5.2)	510.0(±8.0)	539.2±(12.6)	569.7±(6.7)	618.7±(2.8)	611.8±(4.5)	564.6
	M	531.6(±5.3)	516.1(±7.6)	508.1±(14.2)	561.5±(7.0)	609.2±(3.1)	601.4±(4.8)	571.3
23-24	F	551.7(±1.2)	583.0(±1.1)	594.9±(1.3)	591.2±(1.8)	608.1±(2.4)	609.9±(3.4)	589.8
	M	553.3(±1.3)	580.5(±1.2)	589.4±(2.0)	589.6±(2.1)	600.7±(3.0)	609.6±(4.4)	590.2
25-27	F	591.9(±2.4)	608.6(±2.3)	626.2±(3.1)	643.5±(3.6)	672.0±(5.1)	691.3±(5.1)	638.9
	M	597.0(±3.1)	615.4(±3.0)	629.3±(3.9)	657.8±(4.3)	686.4±(6.6)	692.2±(6.1)	646.4

Table 16. Percent age composition of chinook catch by fishing region, combined 1981-83 data. Ages given in European format (freshwater annuli.marine annuli). + = present in very small numbers

Fishing Area	N	Age 0.2	1.1	0.3	1.2	0.4	1.3	0.5	1.4	% 1.
1-5	5107	25	3	39	12	11	8	1	2	25
6-12	1374	40	2	42	7	6	3	+	+	12
21	2781	72	1	20	6	1	1	0	0	8
23-24	12439	59	1	31	7	1	1	+	+	9
25-27	885	44	2	39	6	5	3	+	1	12

Table 17. Mean total age in the catch, overall and for stream and ocean type chinook separately. Analysis of variance tables given for comparisons between areas and months.

Fishing Areas	Month						All Months
	April	May	June	July	August	Sept.	
All Chinook							
1-5	4.30	4.17	4.00	3.83	3.90	4.00	4.02
6-12	3.50	3.77	4.03	3.67	3.40	3.65	3.69
21	3.35	3.33	3.30	3.43	3.15	3.10	3.28
23-24	3.47	3.43	3.43	3.47	3.30	3.07	3.36
25-27	3.63	3.63	3.67	3.63	3.67	3.80	3.66
All Areas	3.58	3.67	3.69	3.61	3.44	3.36	3.57
Ocean Type							
1-5	4.20	4.07	3.80	3.67	3.80	4.00	3.88
6-12	3.50	3.67	3.97	3.47	3.40	3.40	3.59
21	3.25	3.27	3.23	3.47	3.10	3.10	3.24
23-24	3.37	3.37	3.33	3.40	3.30	3.03	3.30
25-27	3.60	3.57	3.57	3.60	3.53	3.50	3.57
All Areas	3.51	3.59	3.58	3.52	3.39	3.27	3.49
Stream Type							
1-5	4.60	4.47	4.33	4.23	4.40	4.30	4.37
6-12	-	4.37	4.53	3.93	3.77	3.90	4.13
21	4.00	3.97	4.07	3.55	3.00	3.10	3.78
23-24	4.00	4.03	4.07	4.03	3.73	3.53	3.90
25-27	4.60	4.30	4.23	3.77	3.90	5.00	4.15
All Areas	4.30	4.22	4.25	3.93	3.78	3.84	4.25

Analysis of Variance Source	df	F	P>F
All Chinook			
Area	4/47	36.15	<0.0001
Months	5/47	2.49	<0.044
A x M	20/47	1.66	<0.077
Ocean Type			
Area	4/47	28.33	<0.0001
Months	5/47	2.22	<0.068
A x M	20/47	1.81	<0.048
Stream Type			
Area	4/39	1.25	<0.0001
Months	5/39	4.84	<0.0016
A x M	19/39	1.43	<0.17

Table 18. Mean age (±SE) of chinook salmon by year and life history type.

Year	All Chinook	Ocean Type	Stream Type
1981	3.57 (0.063)	3.49 (0.067)	3.97 (0.084)
1982	3.47 (0.054)	3.44 (0.049)	4.00 (0.096)
1983	3.66 (0.067)	3.54 (0.061)	4.18 (0.081)

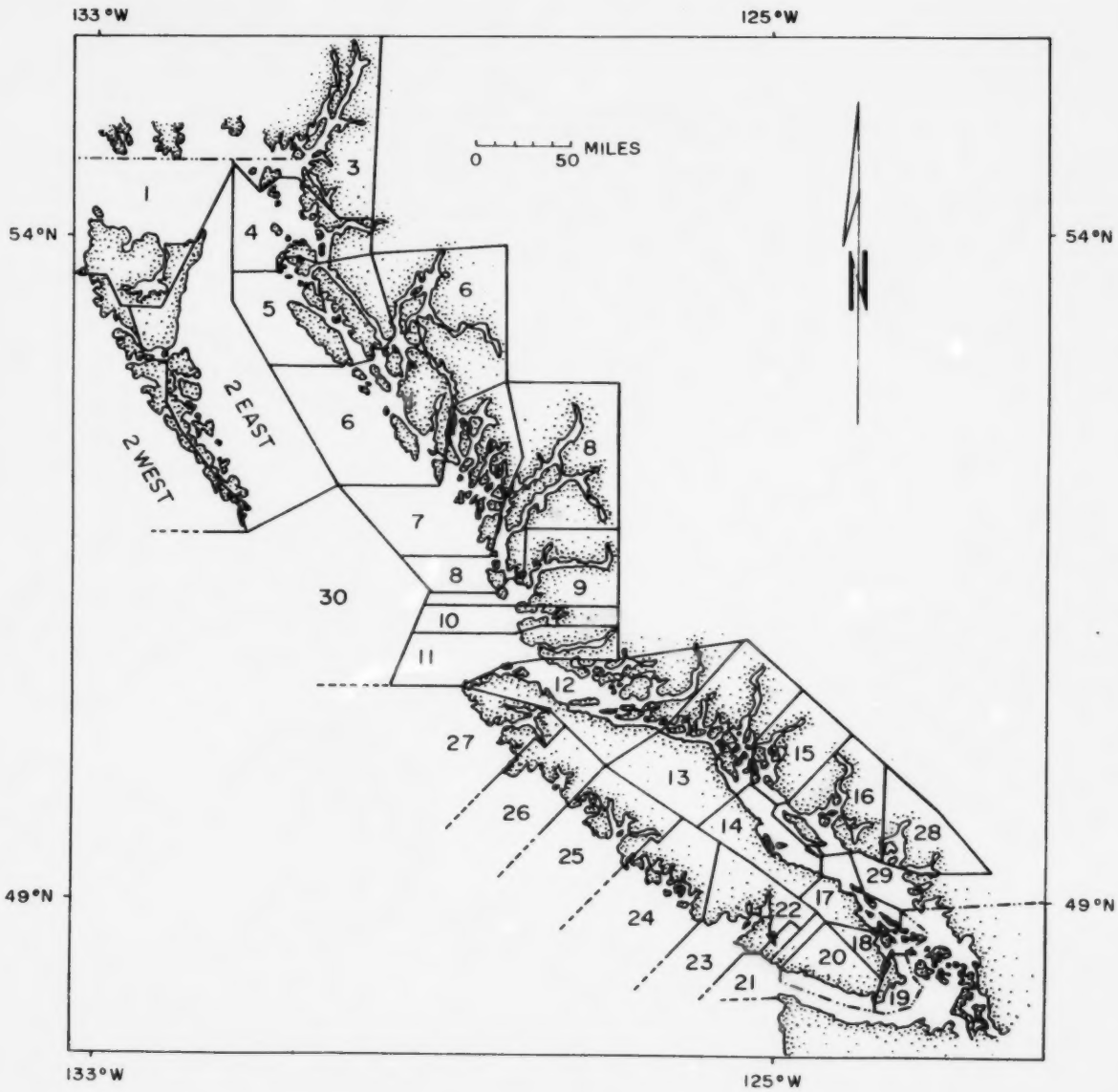

Fig. 1. Map of the British Columbia coast showing fishery statistical areas.

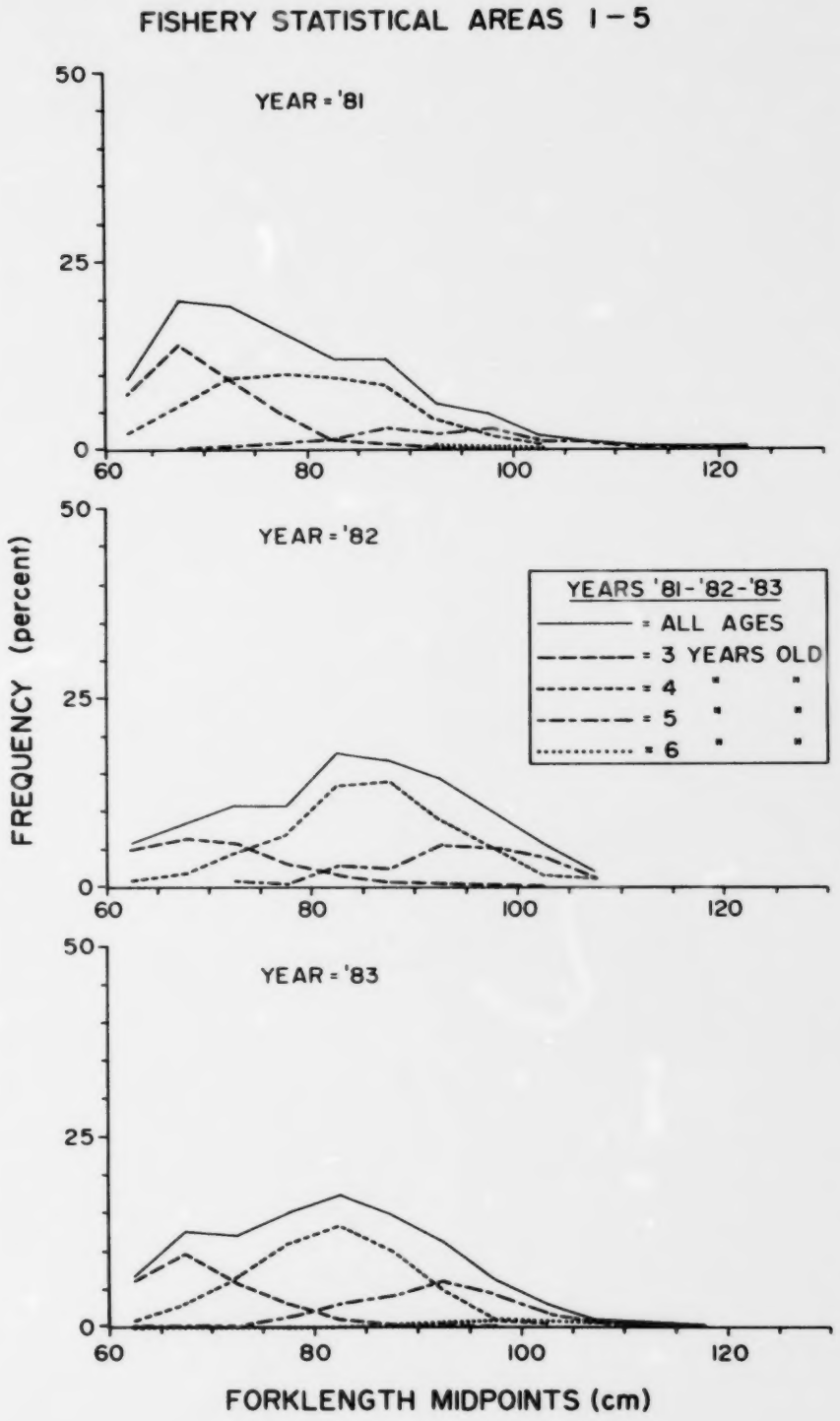

Fig. 2. The length frequency of chinook in percent for each fishery statistical area grouping, age, and year.

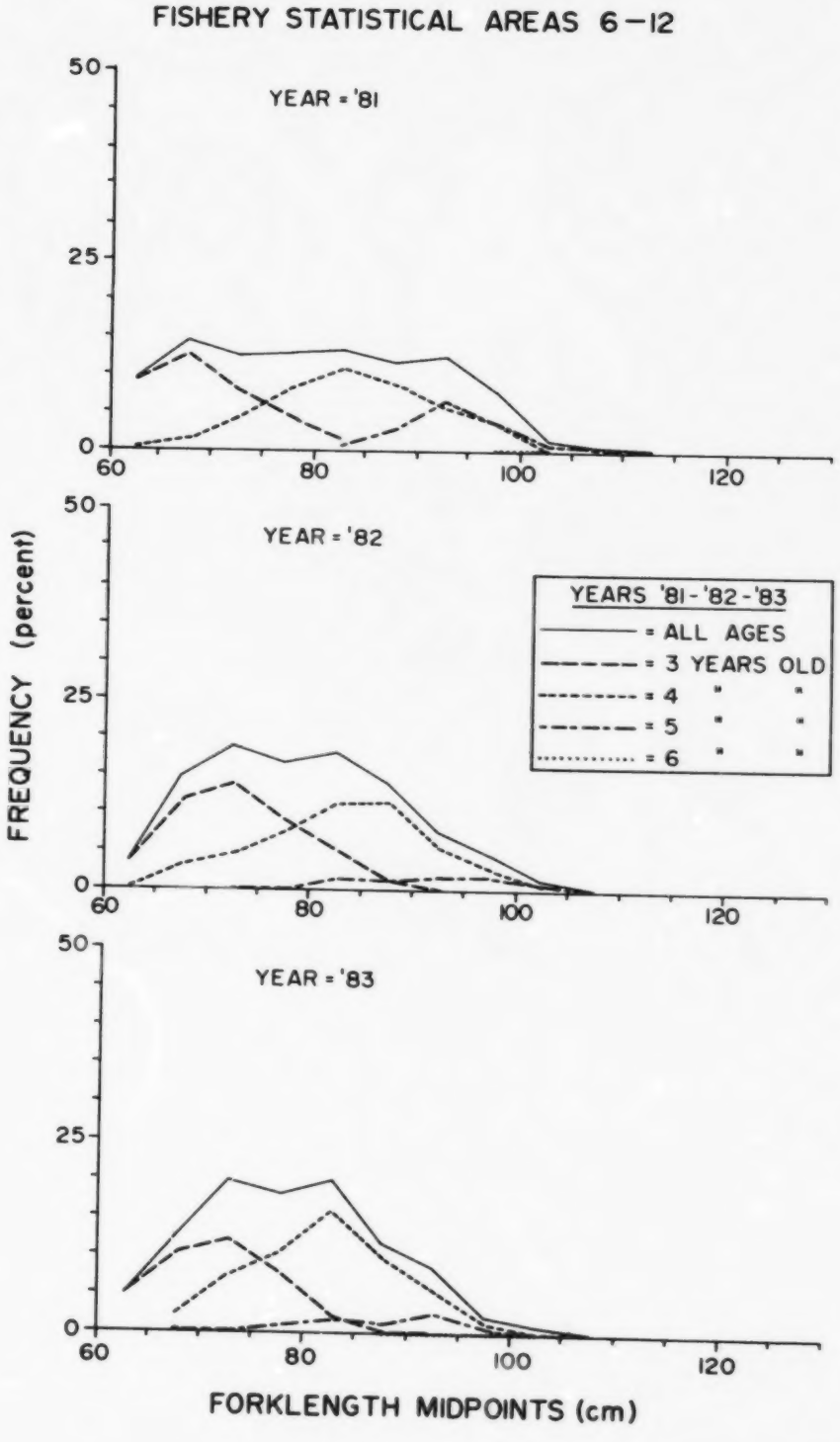
FISHERY STATISTICAL AREAS 6–12
YEAR = '81
YEAR = '82
YEAR = '83
YEARS '81-'82-'83
= ALL AGES
= 3 YEARS OLD
= 4 " "
= 5 " "
= 6 " "
FREQUENCY (percent)
FORKLENGTH MIDPOINTS (cm)
50
25
0
60
80
100
120

Fig. 2 (cont'd).

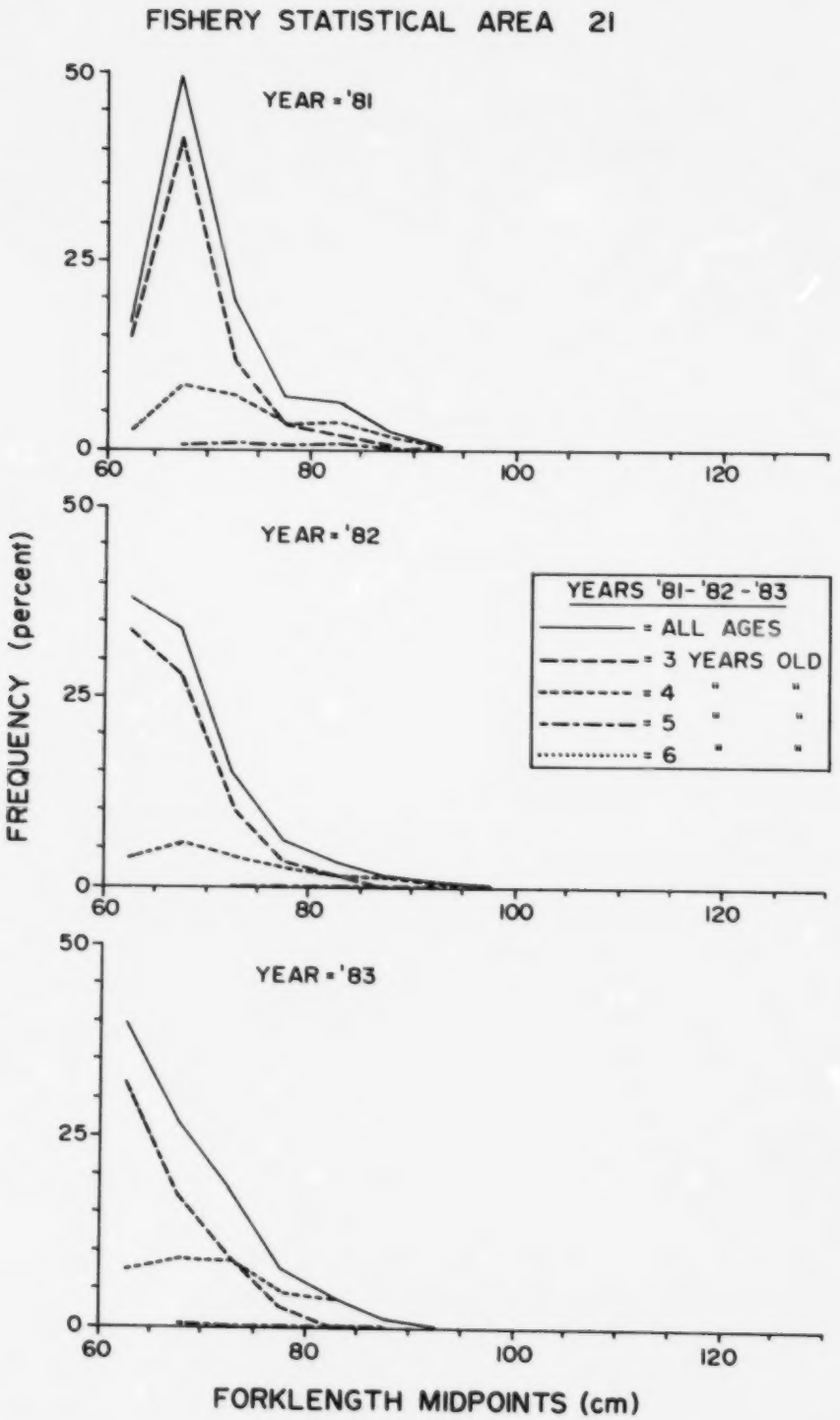
FISHERY STATISTICAL AREA 21
YEAR = '81
YEAR = '82
YEAR = '83
YEARS '81-'82-'83
= ALL AGES
= 3 YEARS OLD
= 4 " "
= 5 " "
= 6 " "
FREQUENCY (percent)
FORKLENGTH MIDPOINTS (cm)
50
25
0
60
80
100
120

Fig. 2 (con'd).

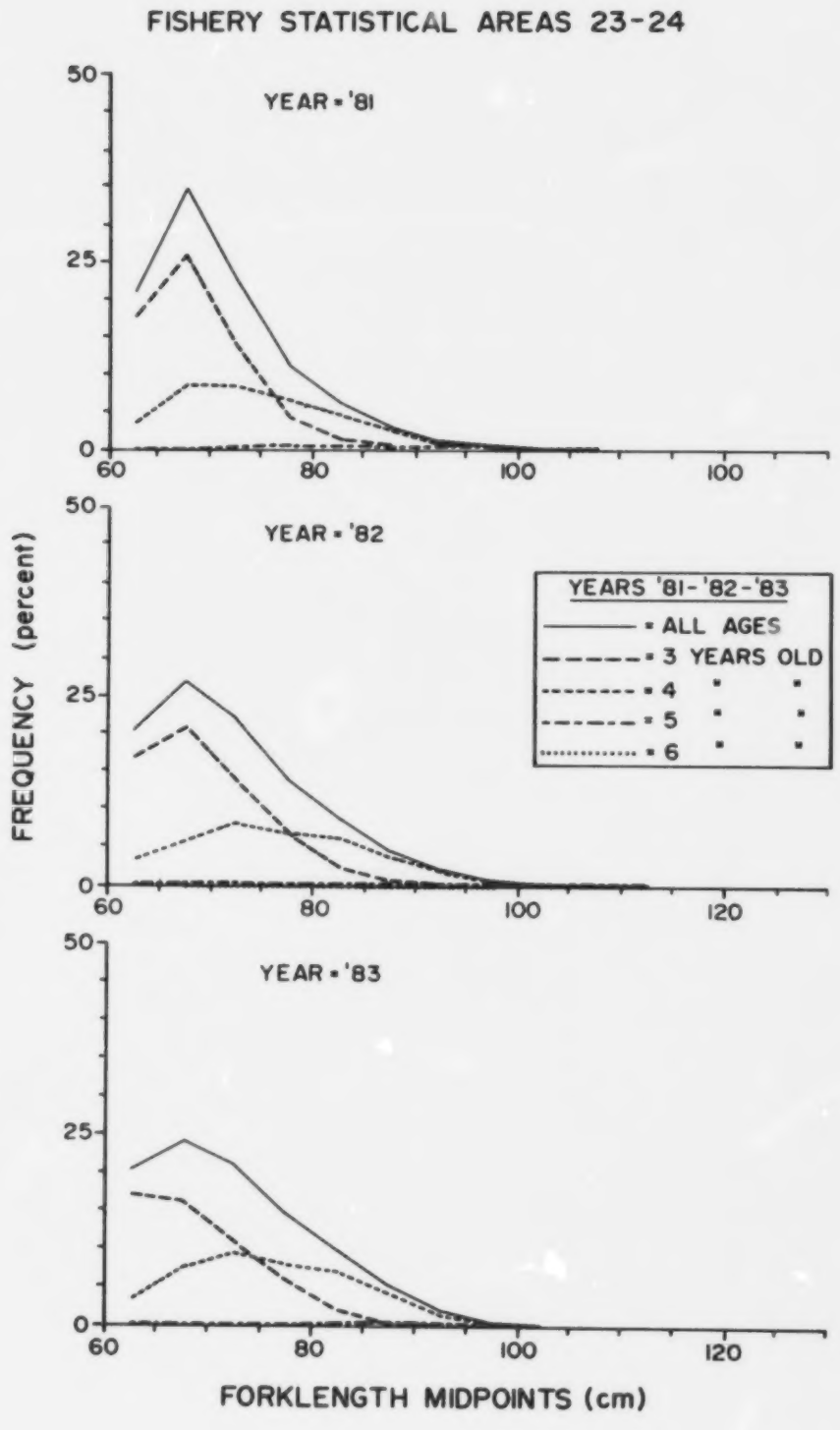
FISHERY STATISTICAL AREAS 23-24
YEAR = '81
YEAR = '82
YEAR = '83
YEARS '81-'82-'83
ALL AGES
3 YEARS OLD
4
5
6
FREQUENCY (percent)
FORKLENGTH MIDPOINTS (cm)
50
25
0
60
80
100
120

Fig. 2 (cont'd).

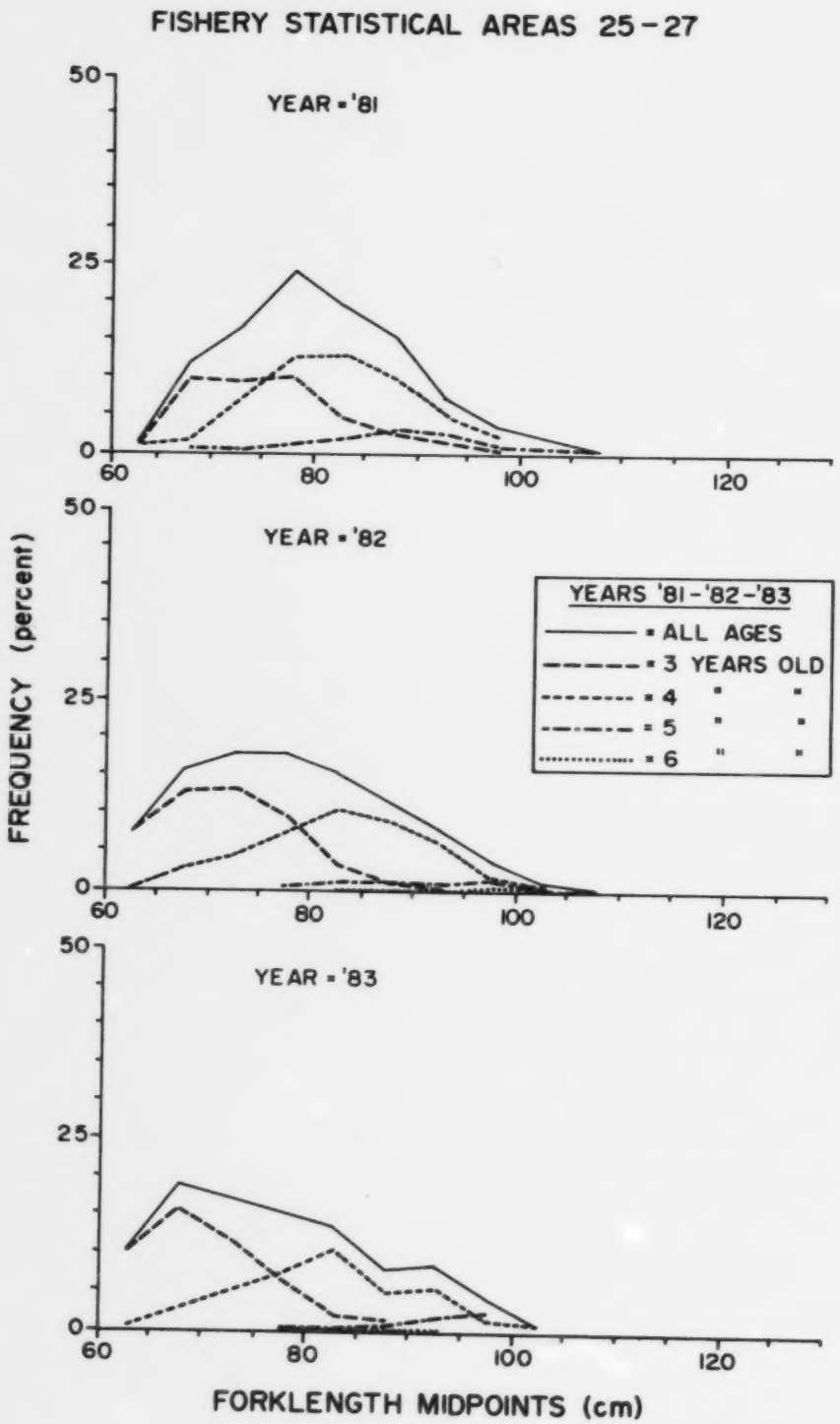
FISHERY STATISTICAL AREAS 25-27
YEAR = '81
YEAR = '82
YEAR = '83
YEARS '81-'82-'83
= ALL AGES
= 3 YEARS OLD
= 4 " "
= 5 " "
= 6 " "
FREQUENCY (percent)
FORKLENGTH MIDPOINTS (cm)
50
25
0
60
80
100
120

Fig. 2 (cont'd).

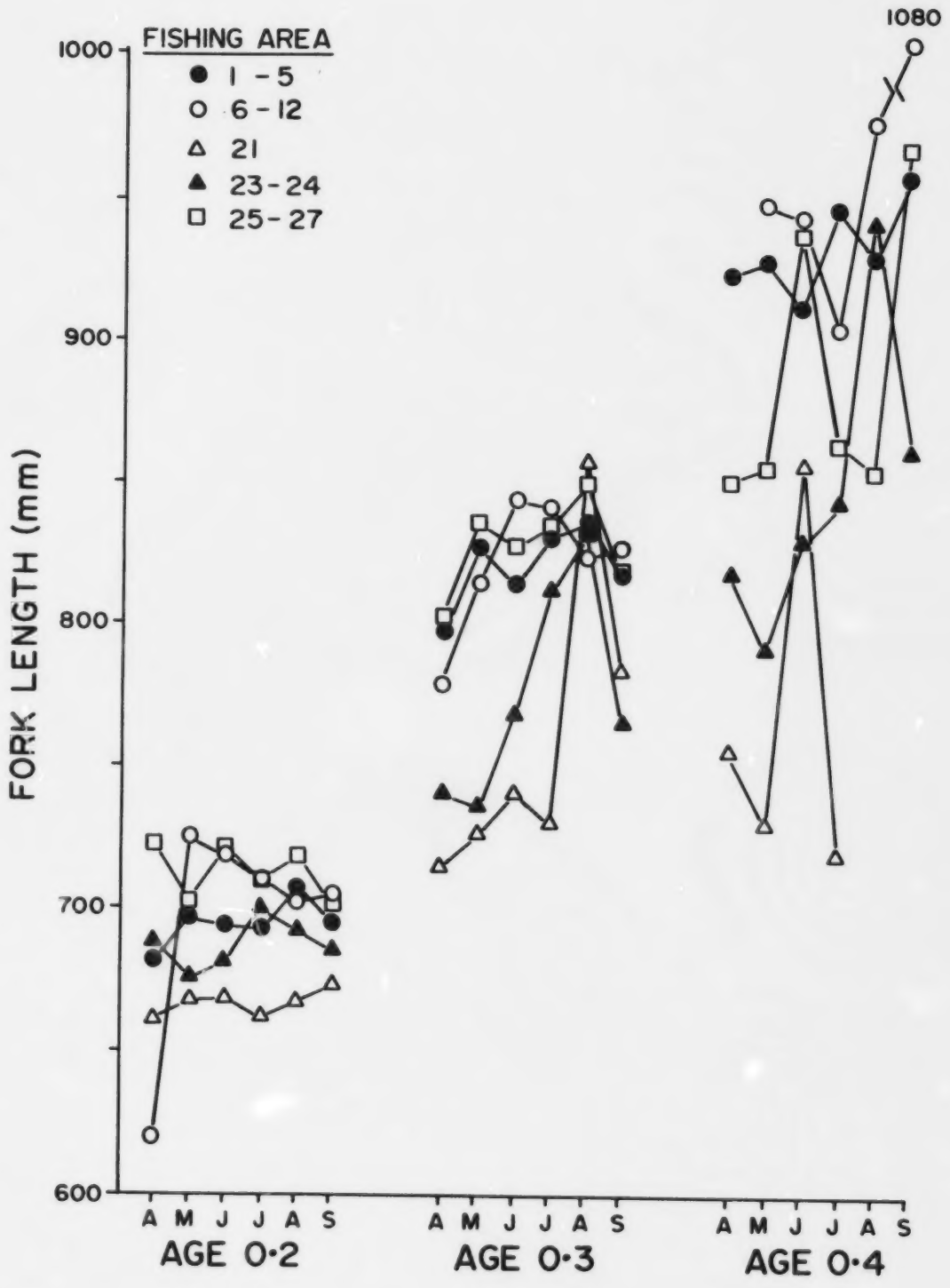

Fig. 3. The average fork length of ocean type chinook by month, age and fishery statistical area grouping.

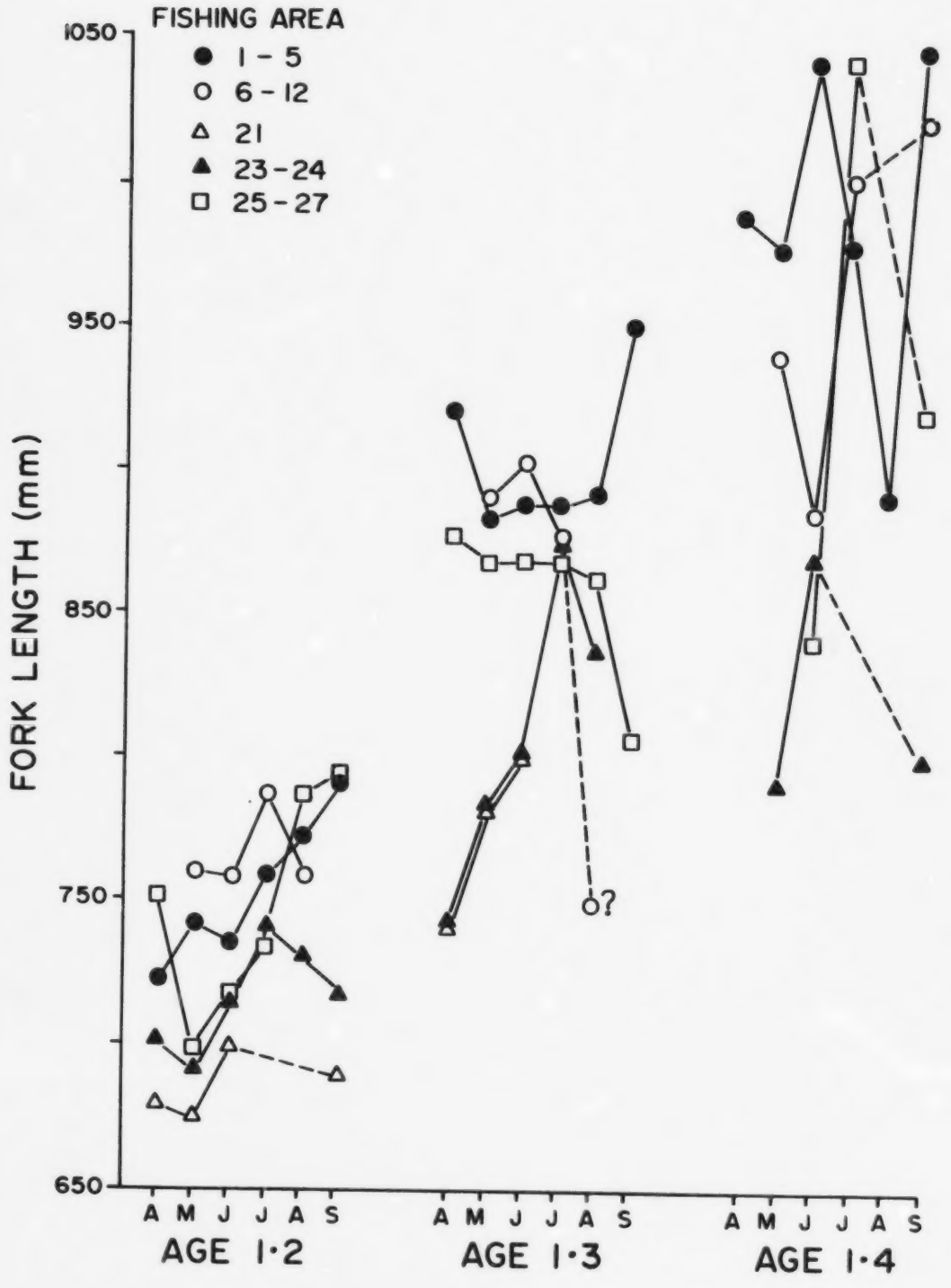

Fig. 4. The average fork length of stream type chinook by month, age and fishery statistical area grouping.

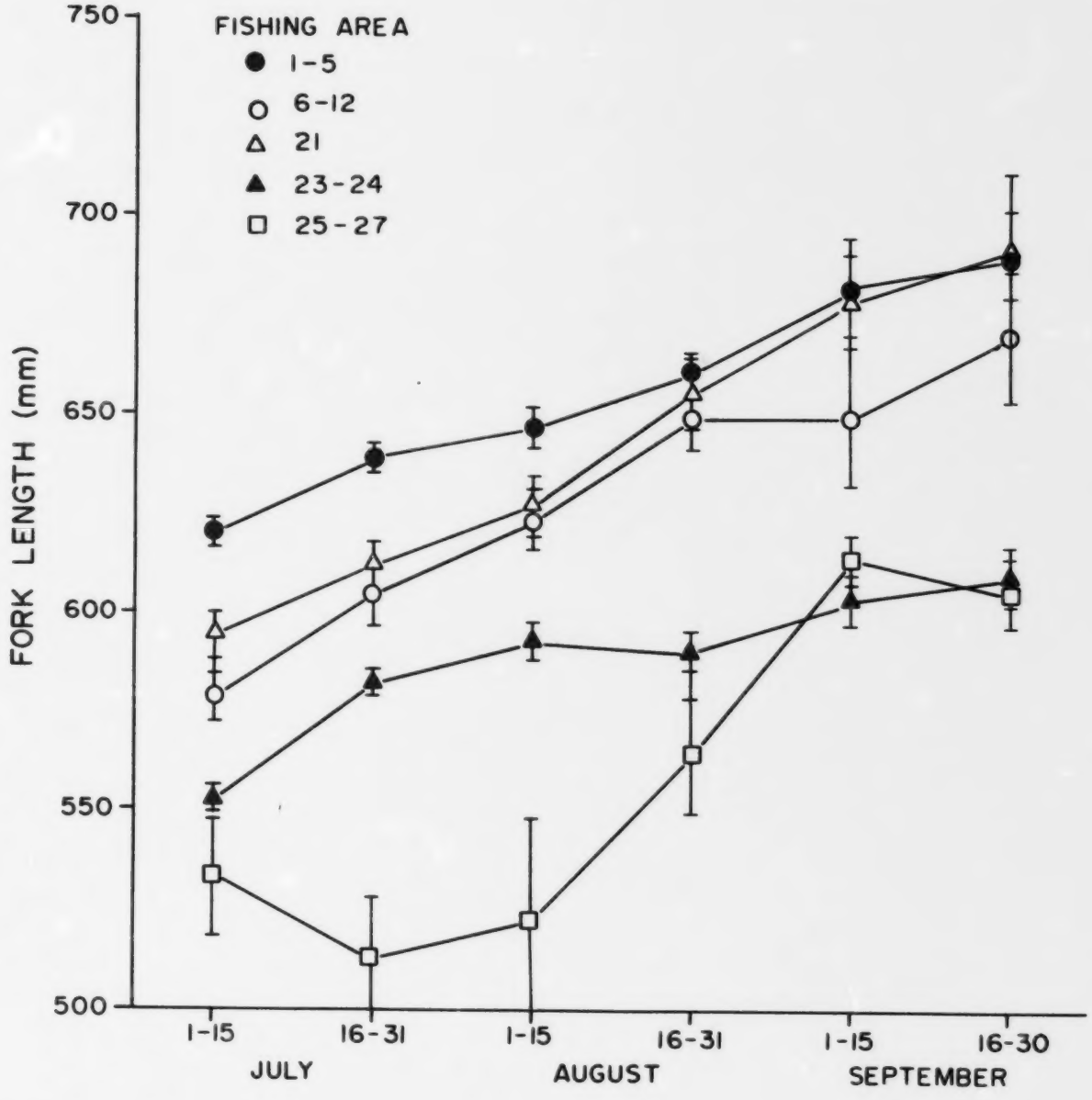

Fig. 5. The average fork length (1981-1983) of coho captured during half month periods in different fishery statistical area groupings. Bars indicate 2 standard errors from the mean.

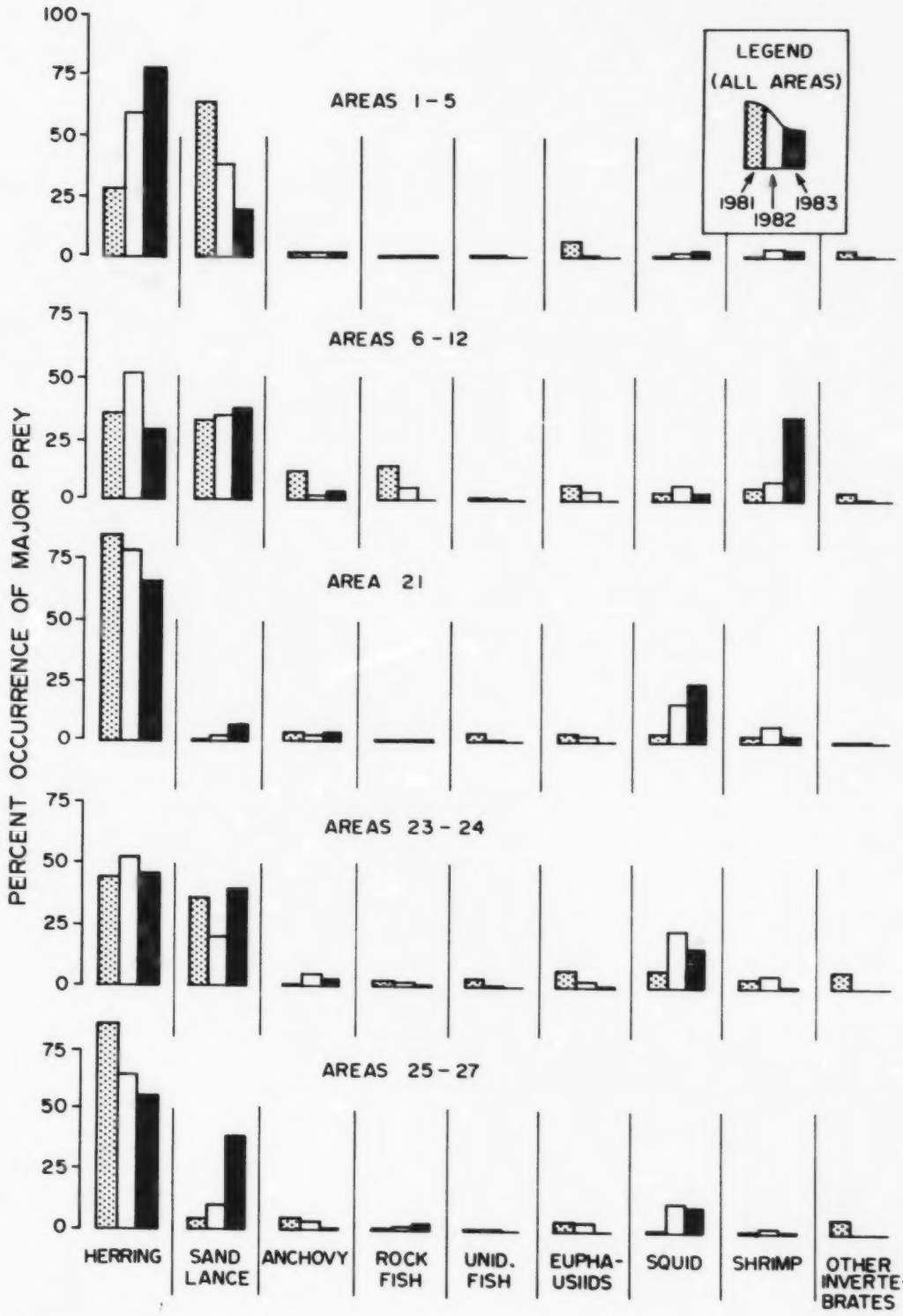

Fig. 6. Diet of chinook in different fishery statistical area groupings each year shown as percent of stomachs examined that contained prey.

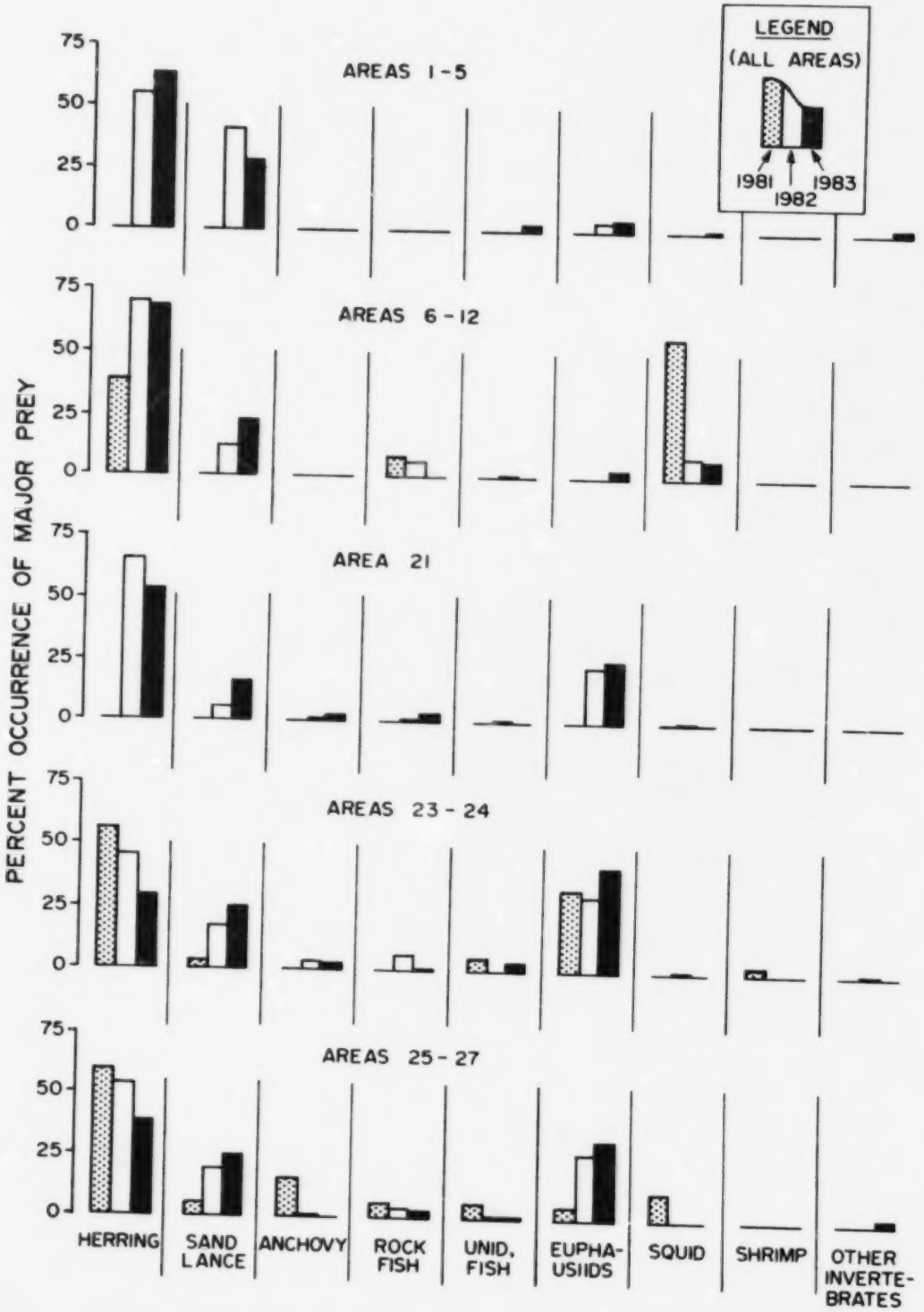

Fig. 7. Diet of coho in different fishery statistical area groupings each year shown as percent of stomachs examined that contained prey. No samples were taken from areas 1-5 or area 21 in 1981.

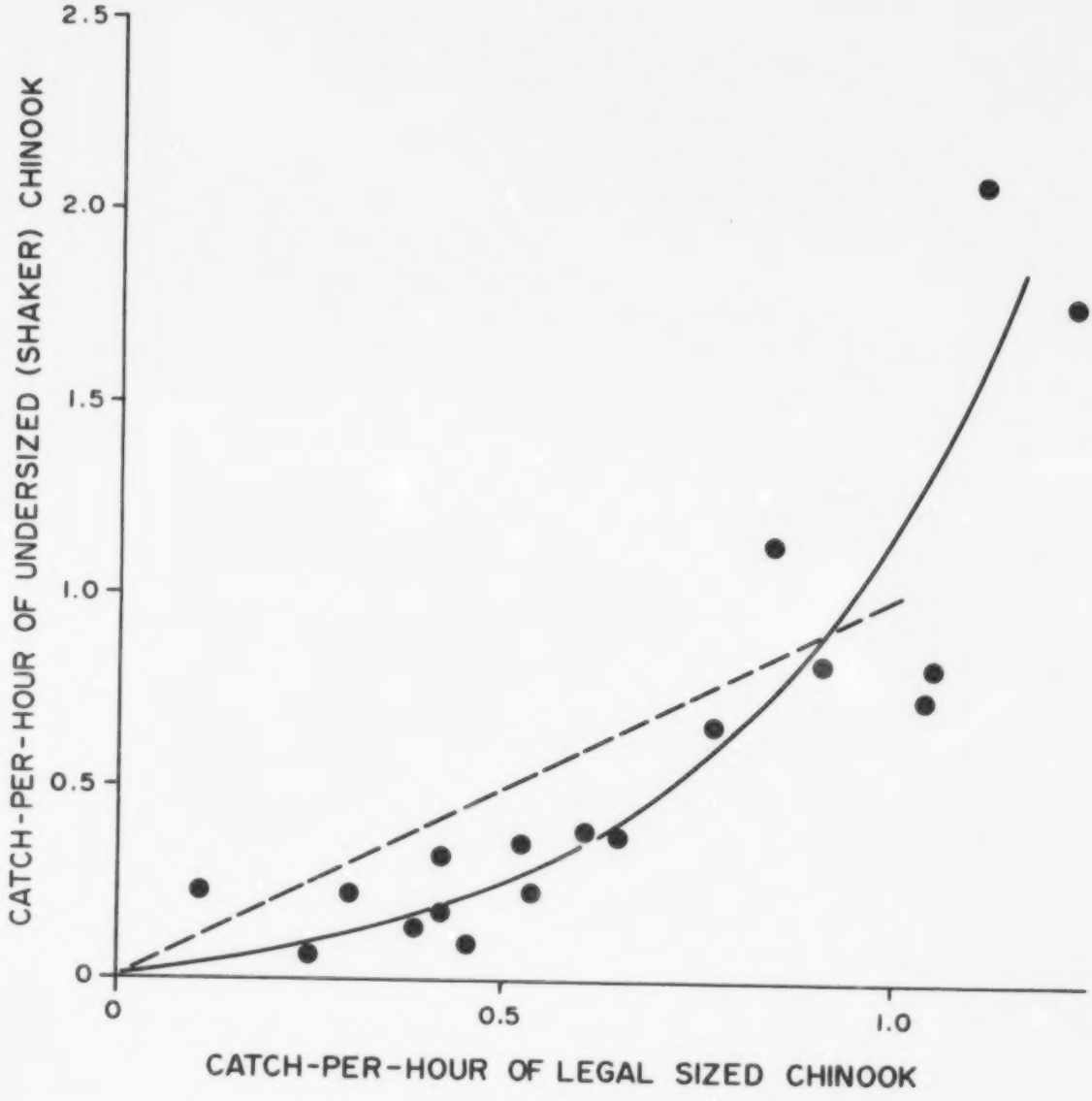

Fig. 8. The relationship between the catch per hour of legal and under-sized chinook. Curved line fitted by eye through the points. Dashed line is the line of equal catch rate.

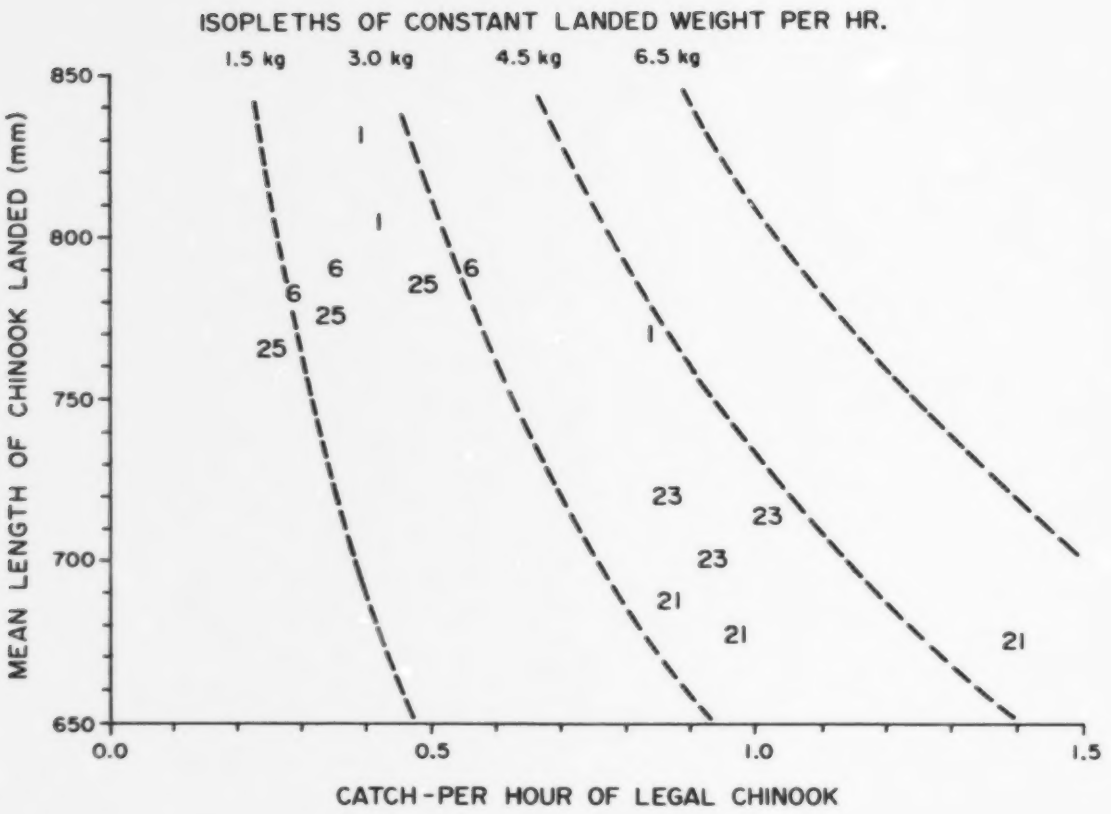

Fig. 9. The relationship between catch rate and size of chinook. Data points are for different fishery statistical area groupings (1=1-5; 6=6-12; 21=21; 23=23-24; 25=25-27) in each year of sampling. Dashed lines show isopleths of equal weight landed per hour of fishing.